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SIXPENCE.
(Registered as a Newspaper.)
FRIDAY,
JANUARY 20, 1905.

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PAGE'S WEEKLY

ENGINEERING · ELECTRICITY SHIPBUILDING MINING IRON & STEEL INDUSTRIES

EDITORIAL & PUBLISHING OFFICES, CLUN HOUSE, SURREY STREET, STRAND, LONDON, W.C.

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Let me know the amount of water you require and I shall be pleased to quote.

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PAGE'S WEEKLY Miscellaneous

Mr. G. H. HUGHES, M.I.Mech.E.,

Consulting and Organising Engineer for Water Works and Industrial Undertakings,

97, QUEEN VICTORIA ST., LONDON, E.C.

Telephone No.: 5754 Bank. Write for particulars

ED. BRAND, *MECHANICAL ENGINEER,* 35, SHAKESPEARE STREET, MANCHESTER.

Modern Wire-Working Machinery,

Such as for Rolling, Drawing, Weaving, Netting, Forming, Automatic Straightening and Cutting, Cabling, Testing, &c.

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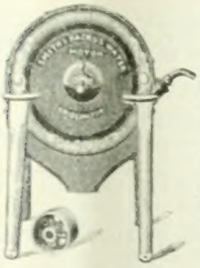

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Will drive any class of Machinery, and work on 15 lb. pressure.

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DEPRECIATION OF FACTORIES, Mines, and Industrial Undertakings, and their Valuation. With Tables and Examples.

By EWING MATHESON, M.Inst.C.E.

The Principles which should guide the Writing off for wear and tear, Obsolete plant; Terminable or wasting properties; Effect on Income-tax; Value defined as for Compulsory purchase; Going concern, or dismantled; Rateable value, rental value.

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E. & F. N. SPON, 125, Strand, London.

JOSEPH BOOTH BROS., LTD.,
RODLEY, LEEDS.

See next week.

LIFTING MACHINERY.

THOS. W. WARD,
ALBION WORKS,
SHEFFIELD.

See Page 20.

MACHINE TOOLS.

THE SHANNON, LTD.,
Ropemaker St., London, E.C.

See Page 84.

OFFICE APPLIANCES

Have you seen our Advertisement on page ~~63~~ 62. A glance at it may save you £500 per annum.—ED. BENNIS & CO., Ltd., BOLTON.

PAGE & ROWLINGSON,

Chartered Patent Agents.

Mr. PAGE, who is a Whitworth Exhibitioner and an Associate Member of the Institute of Civil Engineers, has had a large experience as a Practical Mechanical Engineer, and is specially qualified to deal with the most intricate mechanical problems successfully. *Write for Handbook of Information Free.*

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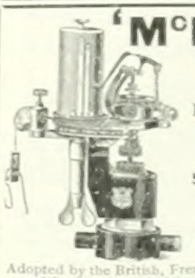

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Special Indicators for Gas, Winding, and Ammonia Engines, and for Motor-Cars.

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The most satisfactory means yet devised for the production of screw threads.

JONES & LAMSON MACHINE CO.,
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97, Queen Victoria Street, LONDON.

PAGE'S WEEKLY Contracts

CONTRACTS.

THE URBAN DISTRICT COUNCIL OF HANDSWORTH.

POWER AND LIGHTING CIRCUITS, PIPEWORK, &c., AND ELECTRICITY METERS.

The Urban District Council of Handsworth invite **TENDERS** for the **SUPPLY** and **DELIVERY** of the following in connection with the Electric Lighting Undertaking :—

CONTRACT No. 10.—POWER and LIGHTING CIRCUITS and FITTINGS in Generating Station.

CONTRACT No. 11.—PIPEWORK, FEED PUMPS, ECONOMISER, &c.

CONTRACT No. 12.—ELECTRICITY METERS.

Tenders will only be considered for the whole of the work covered by each specification, and not for any part thereof.

Copies of the specification, with the conditions of contract, &c., can be obtained on or after Thursday, the 12th January, 1905, from the undersigned on payment of Three Guineas for each specification, which amount will be returned on receipt of a *boná fide* Tender, together with the specifications, drawings, conditions of contract, &c.

The specifications, conditions of contract, and drawings can he seen at (but not obtained from) the offices of the Consulting Engineers, Messrs. KENNEDY AND JENKIN, 17, Victoria Street, Westminster, London, S.W.

Tenders on the prescribed form, in sealed envelopes, and endorsed on the cutside "Electric Light and Power Supply, Tender, Contract No. —," must be delivered at my office at the Council House, Handsworth, before noon on Thursday, February 2nd, 1905.

The Tender of any person or firm paying less than the standard rate of wages current in the district in which the work is executed will not be considered.

The Council do not bind themselves to accept the lowest or any Tender and no allowance will be made for any expense incurred in the preparation of any Tender.

H. WARD, Clerk.

The Council House,
Handsworth, near Birmingham,
January 10th, 1905.

COUNTY OF LONDON—THE LONDON COUNTY COUNCIL (NORTHERN) TRAMWAYS.

TO ENGINEERS, CONTRACTORS, AND OTHERS.

The London County Council invite **TENDERS** for the **ROAD-WORK** and **PLATE-LAYING** required for the Construction, for electrical traction on the conduit system, of the authorised Tramway in Rosebery Avenue, and of a portion of the authorised Tramway in St. John Street Road, in the Metropolitan Boroughs of Holborn and Finsbury.

The total length of the above-mentioned line is equivalent to about 1¾ miles of single track.

The Contractor will be required to use the track rails with their fastenings and the slot rails, which will be furnished by the Council under another contract ; but all the remaining metal work and other materials, and all the special work at junctions, crossings, cross-overs, &c., will be included in the contract.

Persons desiring to submit Tenders may, on and after Friday, December 30th, 1904, obtain the drawings, specification, form of Tender, and other particulars on application to the Council's Chief Engineer, at the County Hall, Spring Gardens, S.W., upon the payment to the Cashier of the Council of the sum of Five Pounds. This amount will, after the Council or its Committee shall have come to a decision upon the Tenders received, but not before, be returned to the tenderer, provided he shall have sent in a *bona fide* Tender and shall not have withdrawn the same, but in no case will the fee be returned unless a *bona fide* Tender is submitted.

Full particulars of the work may be obtained on application at the County Hall, previously to the payment of the fee for the specification, &c.

Tenders must be upon the official forms, and the printed instructions contained therein must be strictly complied with.

The contractors will be bound by the contract to pay to all workmen (except a reasonable number of legally bound apprentices) employed by them wages at rates not less and to observe hours of labour not greater than the rates and hours set out in the Council's list, and such rates of wages and hours of labour will be inserted in and form part of the contract by way of schedule.

Each Tender is to be delivered at the County Hall in a sealed cover, addressed to the Clerk of the London County Council, Spring Gardens, S.W., and marked "Tender for Roadwork and Plate-laying—L.C.C. Tramways."

No Tender will be received after 10 o'clock a.m. on Tuesday, the 24th January, 1905.

Any Tender which does not comply with the printed instructions for Tender may be rejected.

The Council does not bind itself to accept the lowest or any Tender, and it will not accept the Tender of any person or firm who shall on any previous occasion have withdrawn a Tender after the same had been opened, unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk of the London County Council.

County Hall Spring Gardens, S.W.,
December 28th, 1904.

LLANDAFF AND DINAS POWIS RURAL DISTRICT COUNCIL.

SEWERAGE AND SEWAGE DISPOSAL WORKS.

TO CONTRACTORS AND OTHERS.

The Council are prepared to receive

TENDERS FROM PERSONS DESIROUS

of contracting with them for the **CONSTRUCTION** of about 1 mile of **PIPE SEWERS** varying from 12 in. to 15 in. diameter, together with the necessary Manholes ; the **CONSTRUCTION** of **SEWAGE DISPOSAL WORKS**, consisting of Pumping Station, Covered Tanks, Artificial Filters, Laying Out Land, the Formation of Roads and Fencing ; the **SUPPLY** and **ERECTION** of **GAS ENGINES, PUMPS**, &c., in connection with the Sewage Disposal Works for Ely and Fairwater Grove, in the Parish of Llandaff, in the County of Glamorgan.

Plans and Specifications of the Works may be seen, and the Form of Tender obtained, at the office of Mr. BALDWIN LATHAM, M.Inst.C.E., &c., of Parliament Mansions, Victoria Street, Westminster, the Engineer for the Works ; or at the office of Mr. JAMES HOLDEN, A.M.Inst.C.E., the Engineer of the Council, 20, Park Place, Cardiff.

The Quantities of the several Works may be had on application to either of the before-named Engineers on deposit of £10, which will be returned after a Contract has been entered into to every person making a *bonâ fide* Tender, on the return of the Documents entrusted to him. In the event of a Tender being withdrawn the deposit will be forfeited.

Sealed Tenders on the forms supplied, endorsed "Tender for Sewerage Works," are to be delivered at my office at Park House, Park Place, Cardiff, on or before Twelve o'clock noon on Thursday, 26th day of Jauuary, 1905.

The Council do not bind themselves to accept the lowest or any Tender.

M. WARREN,
Clerk to the Council.

Park House, Park Place, Cardiff,
January 7th, 1905.

COMMISSIONER FOR RAILWAYS' OFFICE,
BRISBANE, NOVEMBER 16th, 1904.

2,000 TONS OF STEEL RAILS AND 168 TONS OF STEEL FISH-PLATES.

TENDERS WILL BE RECEIVED AT

this office until 2 p.m. on Tuesday, the 7th March, 1905, endorsed "Tenders for Steel Rails and Fishplates," and accompanied by a preliminary deposit of 1 per cent. on the Tender.

Specification, &c. (price 10s. 6d. per copy), can be obtained at the office of the Chief Engineer, Brisbane, on and after the 16th day of November, 1904, and also at the office of the Agent-General for Queensland, 1, Victoria Street, London, on and after January 3rd, 1905.

The lowest or any Tender will not necessarily be accepted.

T. S. PRATTEN,
Secretary.

TO ROAD BRIDGE CONTRACTORS.

THE RURAL DISTRICT COUNCIL OF

Chertsey, in the County of Surrey, invite **TENDERS** for the **CONSTRUCTION** of the **TWO BRIDGES** known as the Plough Bridges across the River Wey, on the road from Weybridge to Byfleet.

Plans can be seen and copies of the specification obtained on deposit of a postal order of £1 (which will be returned on receipt of a *bonâ fide* tender) at the offices of Mr. R. ST. GEORGE-MOORE, M.Inst.C.E., 17, Victoria Street, Westminster, S.W., the Engineer.

The Council do not bind themselves to accept the lowest or any Tender.

Tenders to be endorsed "Tender for Bridges," and addressed to the Chairman of the Council, to be delivered at the Council Offices, No. 80, Guildford Street, Chertsey, before Twelve o'clock noon on Monday, the 30th January, 1905.

By order,
H. E. PAINE,
Clerk to the Council.

Chertsey, January 4th, 1905.

EAST INDIAN RAILWAY.—The East

Indian Railway Company is prepared to receive **TENDERS** for the **SUPPLY** and **DELIVERY** of :—

(1) DECK BRIDGES (6 ft., 12 ft., 20 ft., and 40 ft. clear spans).

(2) LEATHER BELTING, HIDES, &c.

(3) LAMPS, LAMP FITTINGS, and Miscellaneous Glass, as per specifications to be seen at the Company's offices.

Tenders are to be sent to the undersigned, marked "Tender for Deck Bridges," or as the case may be, not later than Twelve o'clock noon, on Wednesday, the 25th day of January instant.

The Company reserves to itself the right to divide the order, also to decline any tender without assigning a reason, and does not bind itself to accept the lowest or any Tender.

For each specification a fee of £1 1s. is charged, which cannot under any circumstances be returned.

By order,
C. W. YOUNG,
Secretary.

Nicholas Lane, London, E.C.,
January 12th, 1905.

PAGE'S WEEKLY Contracts

THE SOUTH INDIAN RAILWAY COMPANY, Limited,

is prepared to receive

TENDERS FOR THE SUPPLY OF:—

(*a*) 100 STEEL COVERED GOODS WAGONS.
(*b*) 200 Pairs of SPOKE WHEELS and AXLES for ditto.
(*c*) 400 LAMINATED BEARING SPRINGS for ditto.

Specifications and Forms of Tender may be obtained at the Company's offices.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Wagons," or as the case may be, must be left with the undersigned not later than Twelve o'clock Noon of Tuesday, the 24th January, 1905.

The Company is not bound to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 20s. for each copy of Specification (*a*), and of 10s. for each copy of (*b*) and (*c*).

Copies of the Drawings may be obtained at the Office of Sir GEORGE B. BRUCE, 3, Victoria Street, Westminster, on payment of 5s. per sheet

By order,
HENRY W. NOTMAN,
Managing Director.

Company's Offices,
55, Gracechurch Street, London, E.C.
January 6th, 1905.

BOROUGH OF SWINDON.—ELECTRICITY AND TRAMWAYS DEPARTMENT.

LANCASHIRE BOILER, &c.

The Corporation of Swindon invite TENDERS for the SUPPLY and ERECTION of ONE 30 ft. by 8 ft. LANCASHIRE BOILER with downtake superheater, steam, exhaust, and feed piping, &c.

Copies of the general conditions, specification, and forms of Tender may be obtained on application to the Engineer and Manager, Mr. J. G. GRIFFIN, A.M.I.E.E., Electricity Works, Swindon, on payment of a deposit of One Guinea for each copy, which will be returned on receipt of a *bonâ fide* Tender.

Extra copies may be obtained at 5s. each.

The firm whose Tender is accepted will be required to find two responsible sureties, and to enter into a contract to be prepared by and to contain such clauses as the Town Clerk may deem necessary.

Tenders on the prescribed form, and accompanied by the specification and general conditions intact, and endorsed "Tender for Lancashire Boiler," to be delivered to the undersigned before 10 a.m. on Tuesday, Janaary the 24th next.

The Corporation do not bind themselves to accept the lowest or any Tender.

By order,
ROBERT HILTON,
Town Clerk.

Town Hall, Swindon,
December 23rd, 1904.

JOHANNESBURG MUNICIPAL TRAMWAYS.

The Council is prepared to receive

TENDERS FOR:—

VIGNOLES RAILS.
FISHPLATES.
ANGLE STEEL GUARD RAILS, BOLTS, NUTS, COACH SCREWS and DOG SPIKES.

General conditions, specifications, and forms of Tender are now being issued at the Offices of the Town Clerk of Johannesburg. They may be seen on and after Friday, December 30th, at the Offices of the Council's Consulting Engineers, Messrs. MORDEY AND DAWBARN, 82, Victoria Street, Westminster, S.W., and may be obtained from them on payment of Five Guineas, which will be returned on receipt of a *bonâ fide* Tender.

Tenders are to be addressed to Messrs. MORDEY AND DAWBARN, 82, Victoria Street, Westminster, S.W., and must reach them not later than Noon on Thursday, January 26th, 1905.

The Council does not bind itself to accept the lowest or any Tender, and is not responsible for the cost of Tendering.

R. FEETHAM, Town Clerk.

BRADFORD CORPORATION TRAMWAYS.

STEEL GIRDER RAILS AND FISHPLATES.
STEEL POLES.

The Corporation invite TENDERS for the supply and DELIVERY at Bradford of 750 TONS of STEEL GIRDER TRAM RAILS and 37 TONS of FISHPLATES and 80 STEEL POLES, for Electrical Equipment of Tramways.

Sealed Tenders, endorsed "Tender for Steel Rails or Steel Poles," as the case may be, to be sent to me on or before Saturday, the 28th inst.

The contract will be let subject to the Fair Contracts Clauses of the Corporation, which may be seen at the Town Clerk's Office, and which the accepted contractor will be required to sign.

The lowest or any Tender will not necessarily be accepted.

FREDERICK STEVENS,
Town Clerk.

Town Hall, Bradford,
January 11th, 1905.

BOARD OF PUBLIC WORKS.—NOTICE TO CONTRACTORS.

Sealed TENDERS, addressed to the undersigned, will be received up to, but not later than, Ten o'clock a.m. on the 11th day of February, 1905, for EXECUTING certain WORKS at Downies Bay, County Donegal, viz.: An EXTENSION of the existing PIER, DREDGING, ROCK EXCAVATION, &c., according to the plans to be seen at the Coastguard Station, Mulroy, Larganreagh, Letterkenny, County Donegal, and at this Office, where the specification, schedule, form of contract, and printed form of Tender can be had.

The Board will not be bound to accept the lowest or any Tender.

By order,
H. WILLIAMS,
Secretary.

Office of Public Works, Dublin,
December 22nd, 1904.

APPOINTMENTS OPEN.

BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY COMPANY.

ASSISTANT ELECTRICAL ENGINEER.

The Directors are prepared to receive APPLICATIONS (by letter only) from duly qualified candidates for APPOINTMENT as an ASSISTANT ELECTRICAL ENGINEER for the Carriage and Wagon Department.

Candidates should be about 25 years of age, must have had a good general and technical education, and possess a thoroughly practical up-to-date knowledge of direct and tri-phase dynamos, accumulators, and electric fittings, combined with workshop experience gained with an electrical firm of good standing.

Terms: A five years', agreement, with first-class free passage to India.

Salary, Rs. 400 per calendar month.

The Candidate selected will have to pass a medical examination by the Company's consulting physician before appointment.

Letters of application, accompanied by a brief record in chronological order of the candidate's career, with dates and copies (not originals) of testimonials, marked outside "Assistant Electrical Engineers," should be addressed to the undersigned not later than 31st inst.

T. W. WOOD,
Secretary.

Offices, Gloucester House,
Bishopsgate Street Without,
London, E.C.,
January 9th, 1905.

BATTERSEA BOROUGH COUNCIL.

TO ELECTRICAL ENGINEERS.

The Council invite

APPLICATIONS FROM PERSONS NOT

less than 28 years of age for the APPOINTMENT of ELECTRICAL ENGINEER, to take entire charge of the Electric Supply Department and the running of the station. Applicants must have had experience in the working of a three-wire continuous-current system.

Commencing salary £400 per annum.

Forms of application and particulars of duties may be obtained at the Town Hall, Lavender Hill, S.W., and must be delivered to me, duly filled up and accompanied by copies of not more than four recent testimonials, under cover, endorsed "Electrical Engineer," by Mid-day Tuesday, Januury 31st.

The person appointed will be required to reside within the Borough.

Personal canvassing strictly prohibited.

W. MARCUS WILKINS, Town Clerk.

January 12th, 1905.

MARTELL SCHOLARSHIP IN NAVAL ARCHITECTURE

A SCHOLARSHIP of the annual value of £50, and subject to certain conditions, tenable for three years, will be OFFERED for COMPETITION by the Institution of Naval Architects.

Candidates must not be less than 18 or more than 21 years of age on March 1st, 1905, and must at that date have been continuously employed for two years upon naval architecture or marine engineering.

Further particulars may be obtained from the SECRETARY of the Institution of Naval Architects, 5, Adelphi Terrace, London, W.C. (envelopes to be marked "Martell Scholarship").

Applications must be sent in by February 1st, 1905.

THE VICTORIA UNIVERSITY OF MANCHESTER.

The Council desires to proceed to the APPOINTMENT of a PROFESSOR of ENGINEERING.

The Professor will be responsible for the organisation of the Engineering Department, and will have the direction of the Engineering Laboratory.

He may take a consulting practice under specified conditions.

His stipend will be composed of a fixed salary and a share of the fees, and the Council guarantee that the total income will not be less than £1,000 per annum during the first three years.

A detailed statement of the conditions of appointment may be obtained from the Registrar.

Applications, with references and such testimonials (not exceeding three in number) as the candidate may desire, should be sent on or before February 15th to the Registrar.

BUYERS' DIRECTORY.

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages* 43, 45, 46 *and* 48.

In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.

Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. *for each additional section.*

Artesian Well Machinery.
John Z. Thom, Patricroft, Manchester.

Belting.
Binney & Son, Catherine Street, City Road, London, E.C.
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.
Gilmour, W. & O., St. John's Hill, Edinburgh.
Rossendale Belting Co., Ltd., 10, West Mosley Street, Manchester

Boilers.
Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.
Grantham Crank & Iron Co., Ltd., Grantham.
John Thompson, Wolverhampton.

Boilers (Water-tube).
Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.
Cochran & Co. (Annan), Ltd., Annan, Scotland.
Hartley & Sugden, Ltd., Halifax.

Bolts, Nuts, Rivets, etc.
Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.
T. D. Robinson & Co., Ltd., Derby.

Books.
Crosby Lockwood & Son, Stationers' Hall Court, London, E.C.
Griffin, Charles, & Co., Exeter Street, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.
Spon, E. & F. N., 125, Strand, W.C.

Cables.
St. Helen's Cable Co., Ltd., Warrington, Lancashire.

Case-Hardening Compounds.
Hy. Miller & Co., Millgarth Works, Leeds.

Catalogues, Printing, &c.
Atlantic Press, Ltd., Weymouth Street, Manchester.
Southwood, Smith & Co., Ltd., Plough Court, Fetter Lane, London, E.C.
Spottiswoode Advertising Agency, 8, New Street Square, E.C

Chucks.
Fairbanks Co., 78-80, City Road, London, E.C.

Cisterns, Tanks, &c.
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Clutches (Friction).
David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.
H. J. H. King & Co., Nailsworth, Gloucestershire.

Colliery Plants.
Graham, Morton & Co., Ltd., Leeds.

Condensing Plant.
Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.
Mirrlees-Watson & Co., Ltd., Glasgow.

Condensed Water Purifiers.
Lassen & Hjort, 52, Queen Victoria Street, London, E.C.

Consulting Engineers.
Gibbs, John, & Son, 80, Juke Street, Liverpool.
G. H. Hughes, A.M.I.M.E., 97, Queen Victoria Street, London, E.C.

Continental Railway Arrangements.
South Eastern & Chatham Railway Co.

Conveying and Elevating Machinery.
Adolf Bleichert & Co., Leipzig-Gohlis, Germany.
Brown Hoisting Machinery Co., 39, Victoria Street, London, S.W.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Graham, Morton & Co., Ltd., Leeds.
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

Coverings (Boiler).
Magnesia Coverings, Ltd., Washington Station, co. Durham.

Cranes, Travellers, Winches, etc.
Joseph Booth & Bros. Ltd, Rodley, Leeds.
Thomas Broadbent & Sons, Ltd., Huddersfield.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Cranks.
Clarke's Crank & Forge Co., Ltd., Lincoln, England.

Cutters (Milling).
E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham.

Destructors.
Horsfall Destructor Co., Ltd., Armley, Leeds.

Dredges and Excavators.
Delange & Cie, Mce., Hoboken, near Antwerp.
Rose, Downs & Thompson, Ltd., Old Foundry, Hull.

Economisers.
E. Green & Son, Ltd., Manchester.

Ejectors (Pneumatic).
Hughes & Lancaster, 47, Victoria Street, London, S.W.

Electrical Apparatus.
Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.
Broadbent, T. W., Victoria Electrical Works, Huddersfield.
Bruce Peebles & Co., Ltd., Edinburgh.
Brush Electrical Engineering Co., Ltd., Victoria Works Belvedere Road, London, S.E.
Crompton & Co., Ltd., Arc Works, Chelmsford.
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.
Gent & Co., Ltd., Faraday Works, Leicester.
Greenwood & Batley, Ltd., Albion Works, Leeds.
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., The Silvertown, London, E.
Mather & Platt, Ltd., Salford Iron Works, Manchester.
Matthews & Yates, Ltd., Swinton, Manchester.
Mix and Genest, Berlin, W., Germany.
Nalder Bros. & Thompson, 34, Queen Street, London, E.C
Newton Brothers, Full Street, Derby.
Phœnix Dynamo Manufacturing Co., Bradford, Yorks.
Premier Electrolyte Co., 26, Spital Square, London, E.
Simplex Steel Conduit Co., Ltd., 20, Bucklersbury, London, E.C.
Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, London, E.C.
Turner, Atherton & Co., Ltd., Denton, Manchester.
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Hudswell, Clarke & Co., Ltd., Leeds, England.

Engines (Stationary).
Allis-Chalmers Co., 533, Salisbury House, Finsbury Circus, London, E.C.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Mirrlees Watson Co., Ltd., Glasgow.
Soest, L., & Co., Ltd., 114-116, Victoria Street, London, S.W.

Engines (Traction).
Jno. Fowler & Co. (Leeds), Ltd., Steam Plough Works, Leeds.
Garrett & Sons, Ltd., Richard, Leiston, R.S.O., Suffolk.

Engravers.
Jno. Swain & Son, Ltd., 58, Farringdon Street, London, E.C.

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Lassen & Hjort, 52, Queen Victoria Street, London, E.C.

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Capel Fan Co., 13, Moseley Street, Newcastle-on-Tyne.
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Gibbs, John & Son, 80, Juke Street, Liverpool.
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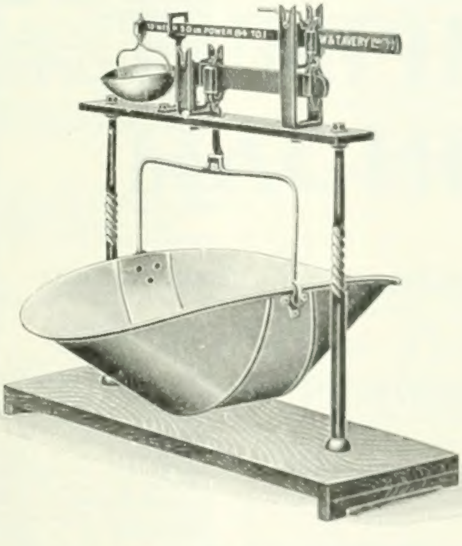

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Brett's Patent Lifter Co., Ltd. Coventry

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J. H. Williams & Co., Brooklyn, New York, U.S.A

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Graham, Morton & Co., Ltd., Leeds.
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Power-Gas Corporation, Ltd., 39, Victoria Street, London, S.W.

Gauge Glasses.
J. B. Treasure & Co., Vauxhall Road, Liverpool.

Gauges.
Klinger, Richard & Co., 66, Fenchurch Street, London, E.C.

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Hamilton & Co., J. B., 145, Cannon Street, E.C
Wild, M. F., & Co., Corporation Street, Birmingham.

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Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

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Davis & Primrose, Leith Ironworks, Edinburgh.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

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William Asquith, Ltd., Highroad Well Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

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Icemaking and Refrigerating Machinery.
H. J. West & Co., 114-118, Southwark Bridge Road, London, S.E.

Indicators.
Dobbie McInnes, Ltd., 41 & 42, Clyde Place, Glasgow.
Hannan & Buchanan, 75, Robertson Street, Glasgow.

Iron and Steel.
Askham Bros. & Wilson, Ltd., Sheffield.
Consett Iron Co., Ltd., Consett, Durham, and Newcastle-on-Tyne.
Fairley & Sons, James, Old Mint, Shadwell Street, Birmingham.
Farnley Iron Co., Ltd., Leeds England.
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Hadfield's Steel Foundry Co., Ltd., Sheffield.
J. Frederick Melling, 14, Park Row, Leeds, England.
Parker Foundry Co., Derby.
Purden, John & Sons, Lambhill Forge, by Maryhill, Glasgow.
Walter Scott, Ltd., Leeds Steel Works, Leeds, England.
Gilbert Thompson & Co., 116, Victoria Street, London, S.W.
Woodhouse & Rixson, Sheffield.

Ironwork (Constructional).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Ironwork (Galvanised).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

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Richard Klinger & Co., 66, Fenchurch Street, London, E.C.

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Northern Engineering Co. (1900 Ltd., King Cross, near Halifax.

Laundry Machinery.
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Lifts.
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Reliance Lubricating Oil Co., The, 19 & 20, Water Lane, Great Tower Street, London, E.C.
Matthew Wells & Co., Hardman Street Oil Works, Manchester.

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George Addy & Co., Waverley Works, Sheffield.
Bateman's Machine Tool Co., Hunslet, Leeds.
Hy. Berry & Co., Ltd., Leeds.
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Bradbury & Co., Ltd., Wellington Works, Oldham.
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Jones & Lamson Machine Co., 97, Queen Victoria Street, London, E.C.
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Charles Winn & Co., St. Thomas Works, Birmingham.
Yorkshire Machine Tool and Engineering Works, Liversedge, Yorks.

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Delta Metal Co., Ltd., 110, Cannon Street, London, E.C.
Magnolia Anti-Friction Metal Co., Ltd., of Great Britain, 49, Queen Victoria Street, London, E.C.
Phosphor Bronze Co., Ltd., Southwark, London, S.E.

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Humbolt Engineering Co., Kalk, near Cologne, Germany.

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Hall & Co., B. J., 39, Victoria Street, London, S.W.
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Partridge & Cooper, Ltd., 191-192 Fleet Street, London, E.C.
Rockwell-Wabash Co. Ltd., 69, Milton Street, London, E.C.
Shannon, Ltd., Ropemaker Street, London, E.C.
Titan Binder Co., 31, Queen Victoria Street, London, E.C.
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Wells, M., & Co., Hardman Street Oil Works, Manchester.

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Beldam Packing & Rubber Co., 93-94, Gracechurch Street, London, E.C.
Frictionless Engine Packing Co., Ltd., Hendham Vale Works, Harpurhey, Manchester.
Lancaster & Tonge, Ltd., Pendleton, Manchester.
Redfern & Co., S., Swan Lane, New Brown Street, Manchester.
Quaker City Rubber Co., Coronation House, Lloyd's Avenue, E.C.
United Kingdom Self-Adjusting Anti-Friction Metallic Packing Syndicate, 14, Cook Street, Liverpool.
United States Metallic Packing Co., Ltd., Bradford,
J. Bennett von der Heyde, 6, Brown Street, Manchester.

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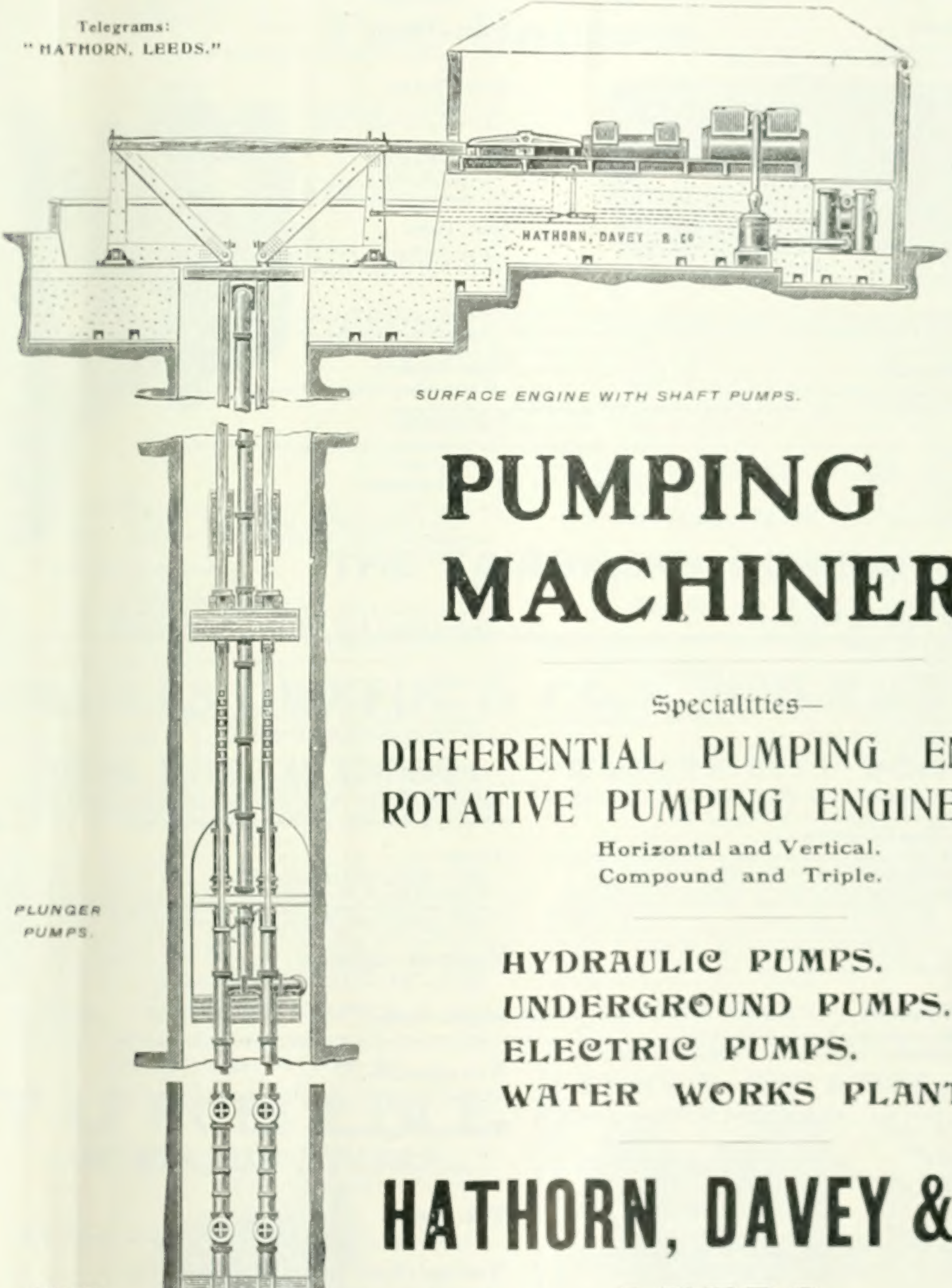

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Elliott & Fry, 55, Baker Street, London, W.

Photographic Apparatus.

Marion & Co., Ltd., 22, 23, Soho Square, London, W.

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Samson & Co., Garforth, near Leeds.
Stone & Co., J. B., 135, Finsbury Pavement, London, E.C.

Pistons.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

Porcelain.

Gustav Richter, Charlottenburg, near Berlin, Germany.

Presses (Hydraulic).

Greenwood & Batley, Albion Works, Leeds.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Publishers.

Crosby Lockwood & Son, 7, Stationers' Hall Court, London, E.C.
Charles Griffin & Co., Ltd., Exeter Street, Strand, London, W.C.
Spon, E. and F. N., 125, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.

Pulleys.

H. J. H. King & Co., Nailsworth, Glos.

Pumps and Pumping Machinery.

Blake & Knowles Steam Pump Works, Ltd., 153, Queen Victoria Street, London, E.C.
Drum Engineering Co., 27, Charles Street, Bradford.
Enke, Carl, Schkeuditz-Leipzig, Germany.
Fairbanks, Morse & Co., 126, Southwark Street, London, S.E.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
J. P. Hall & Sons, Ltd., Peterborough.
Hathorn, Davey & Co., Ltd., Leeds, England.
Positive Rotary Pumps, Ltd., 23, Northumberland Avenue, London, W.C.
Tangyes, Ltd., Cornwall Works, Birmingham.

Radial Drilling Machines.

William Asquith, Ltd., Highroad Well Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.

Rails.

Wm. Firth, Ltd., Leeds.

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Nye, A. W., 110, Cannon Street, London, E.C.
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Mellowes & Co., Sheffield.

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Graham, Morton & Co., Ltd., Leeds.
Head, Wrightson & Co., Ltd., Thornaby-on-Tees.

Ropeways (Aerial).

Bullivant & Co., Ltd., 72, Mark Lane, London, E.C

Scientific Instruments.

Cambridge Scientific Instrument Co., Ltd. Cambridge.

Stampings.

Thos. Smith's Stamping Works, Ltd., Coventry.
Thomas Smith & Sons of Saltley, Ltd., Birmingham.

Stamps (Rubber).

Rubber Stamp Co., 1 & 2, Holborn Buildings, Broad Street Corner Birmingham.

Stamps (Metal).

Edward Pryor & Son, 68, West Street, Sheffield.

Steam Traps.

British Steam Specialties, Ltd., Fleet Street, Leicester.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

Steam Wagons.

Thornycroft & Co., Ltd., J. I., Chiswick, London, W.
Yorkshire Patent Steam Wagon Co., Pepper Road, Hunslet, Leeds

Steel Tools.

Saml. Buckley, St. Paul's Square, Birmingham.
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.

Stokers.

Ed. Bennis & Co., Ltd., Bolton, Lancs.
Meldrum Brothers Ltd., Atlantic Works, Manchester.

Stone Breakers.

S. Pegg & Son, Alexander Street, Leicester.

Superheaters.

A. Bolton & Co., 40, Deansgate, Manchester.

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Howard Bros., 10, St. George's Crescent, Liverpool, and 100c, Queen Victoria Street, London, E.C.
International Time Recording Co., 171, Queen Victoria Street, London, E.C.

Tubes.

Premier Boiler Tubes, Ltd., 28, Victoria Street, London S.W.
Thomas Piggott & Co., Ltd., Spring Hill, Birmingham.
Tubes, Ltd., Birmingham.

Turbines.

G. Gilkes & Co., Ltd., Kendal.
Greenwood & Batley, Albion Works, Leeds.
S. Howes, 64, Mark Lane, London, E.C.

Typewriters.

Elliott-Fisher Co., 85, Gracechurch Street, London, E.C.
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Holmes & Co., W. C., Huddersfield.
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Lassen & Hjort, 52, Queen Victoria Street London, E.C.

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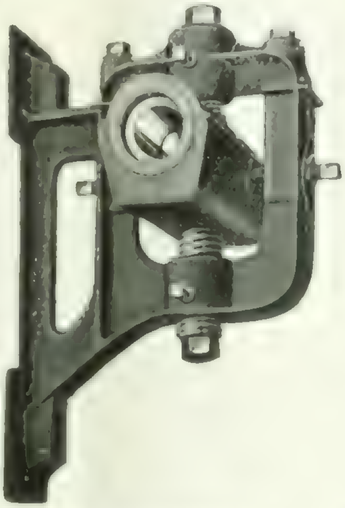

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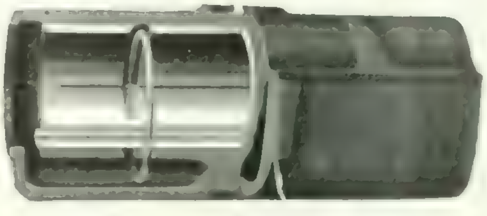

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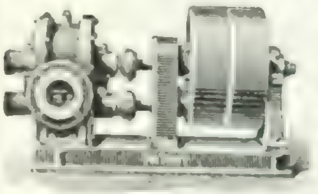

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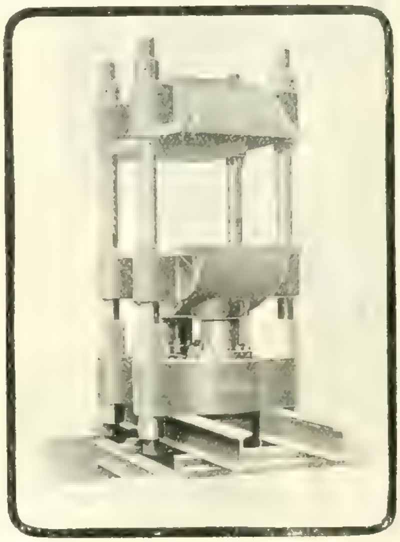

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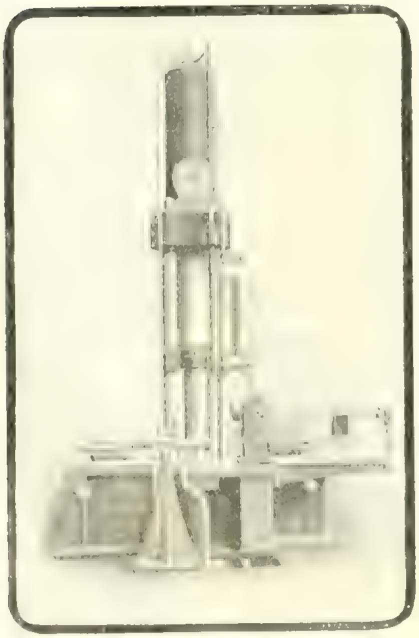

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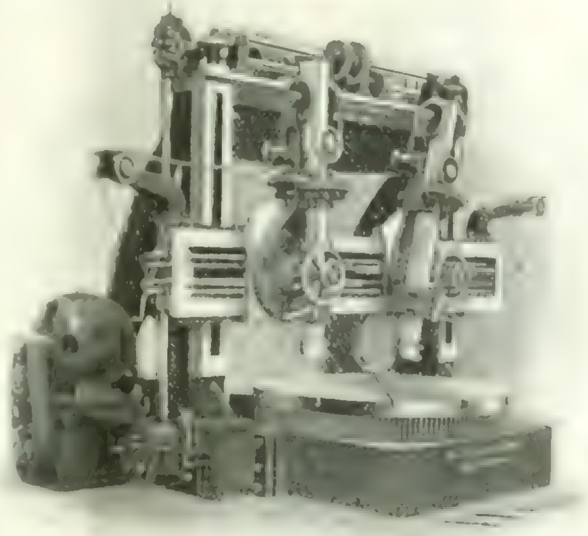
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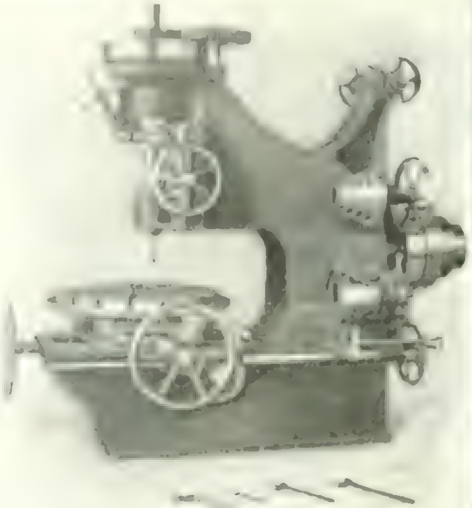
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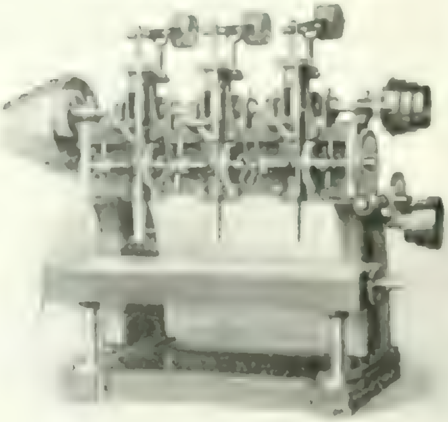
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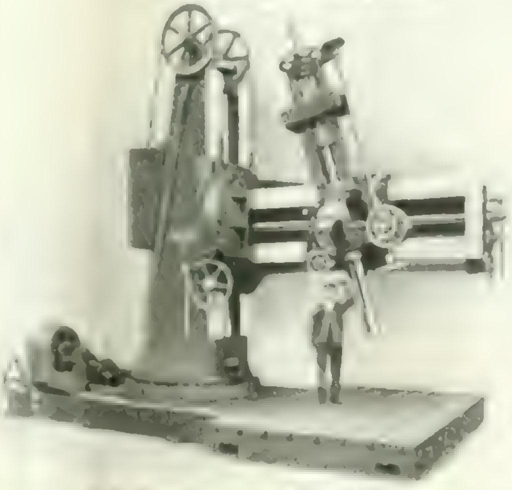
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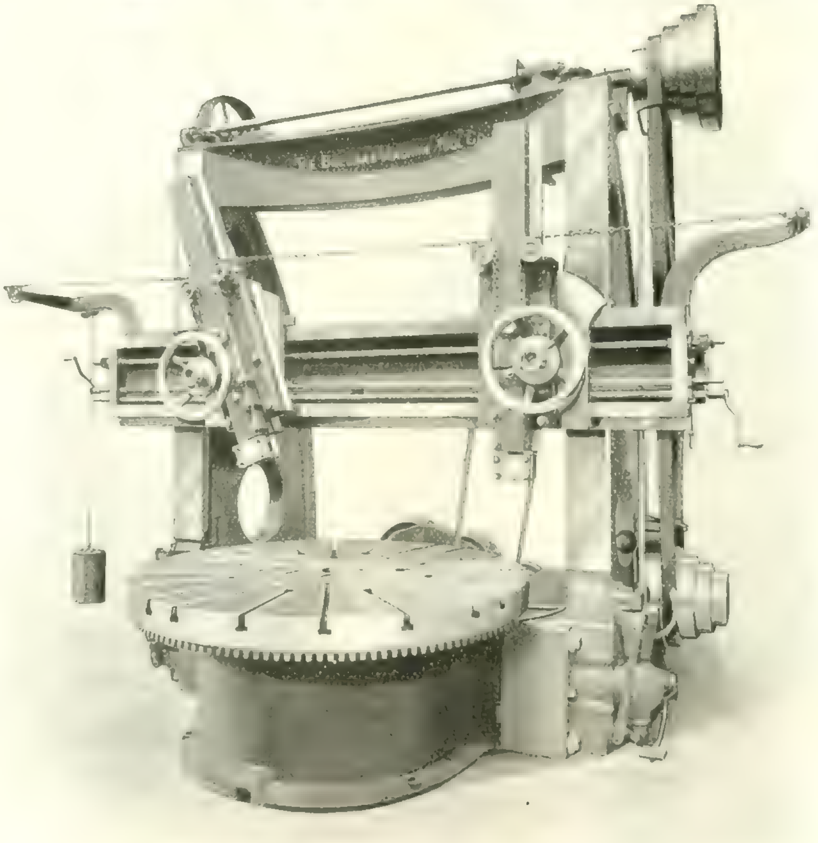

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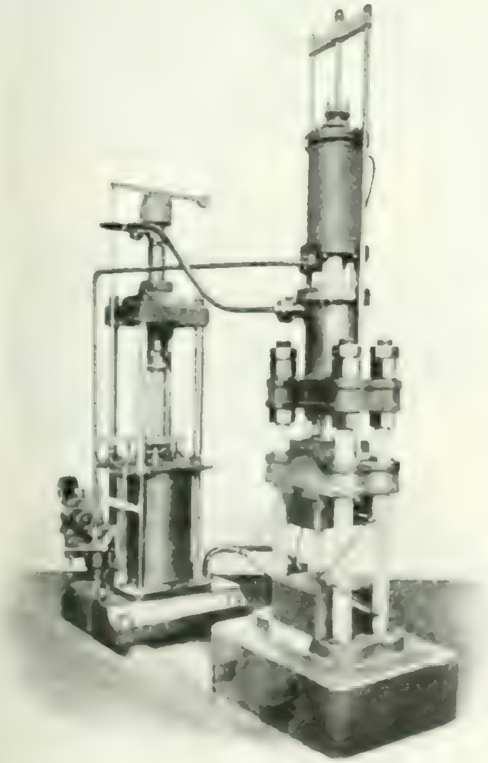

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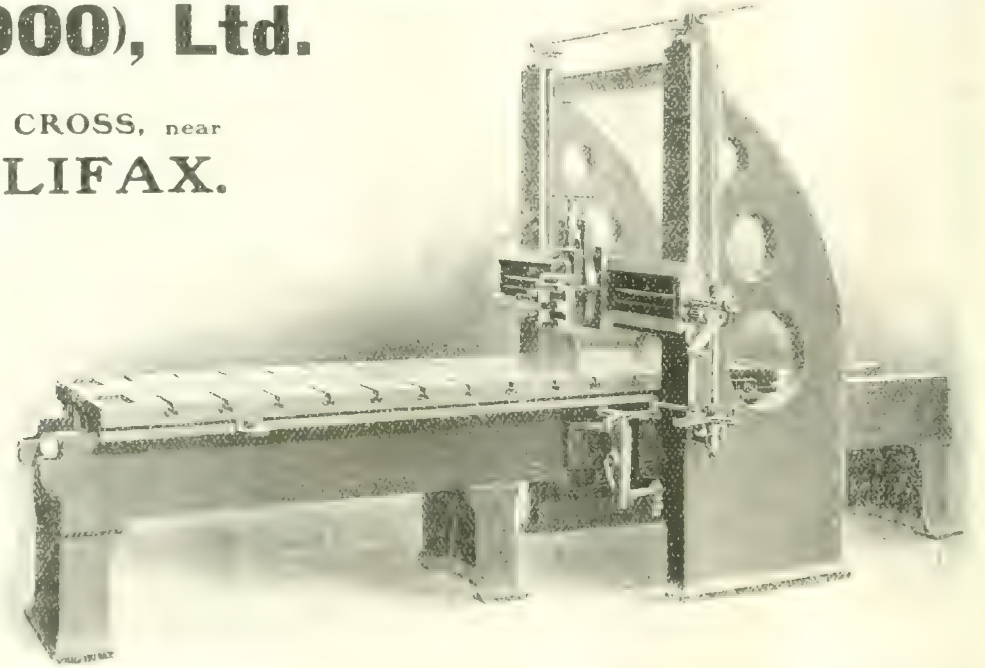

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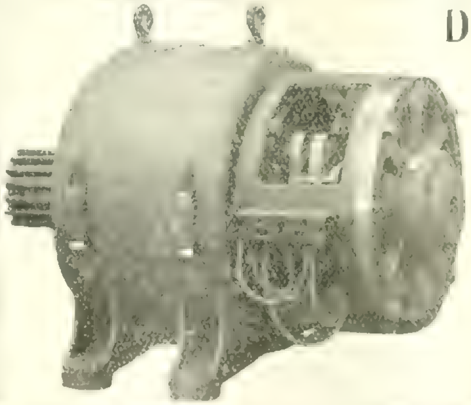

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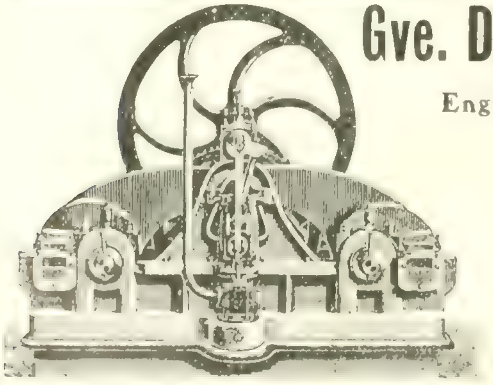

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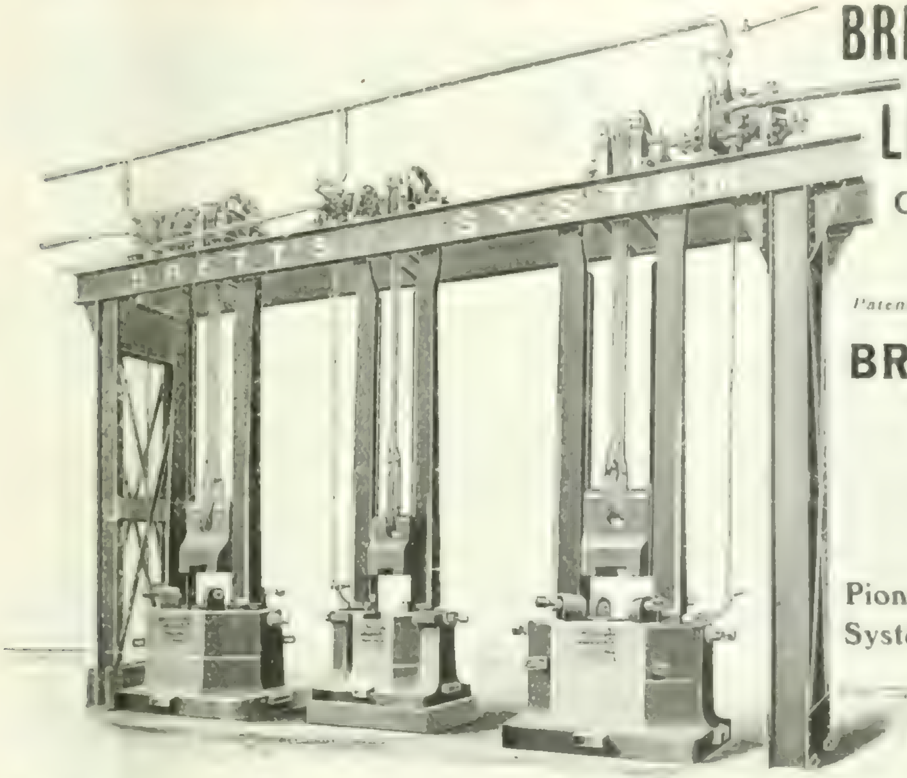

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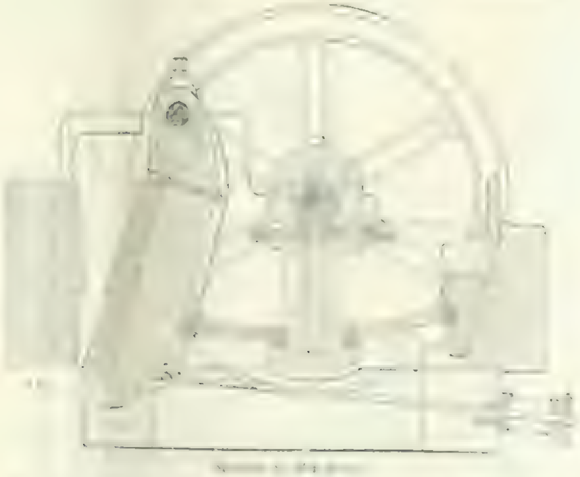

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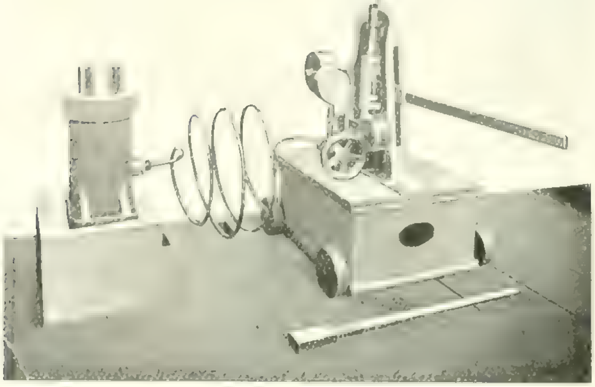

BOILER FLUE APPARATUS.

This illustration shows an apparatus for pushing up boiler flues. The cylinder and ram can be got into a flue of 24 in. diameter, and is capable of dealing with plates up to $\frac{3}{4}$ in. of thickness cold.

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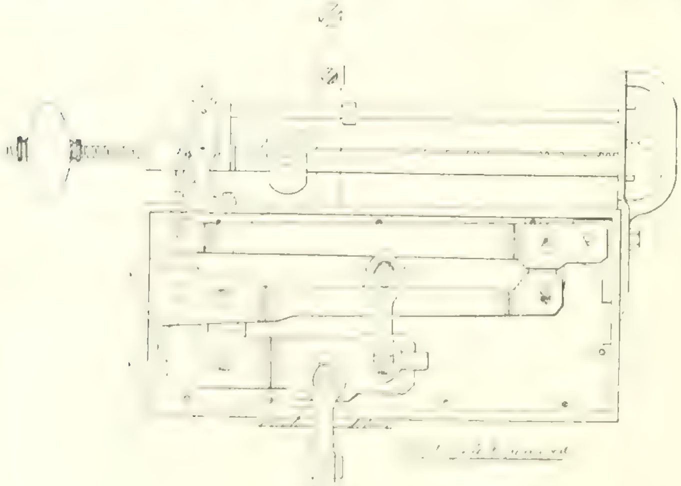

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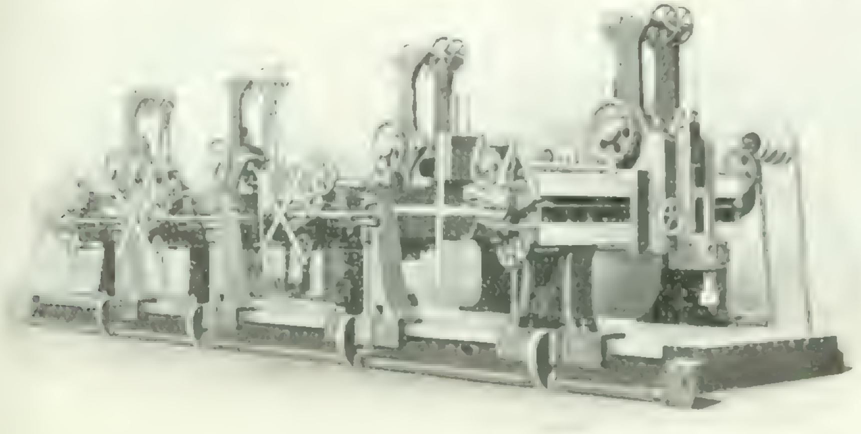
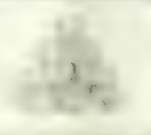


Locomotive Frame-plate Slotting Machine (85 tons).



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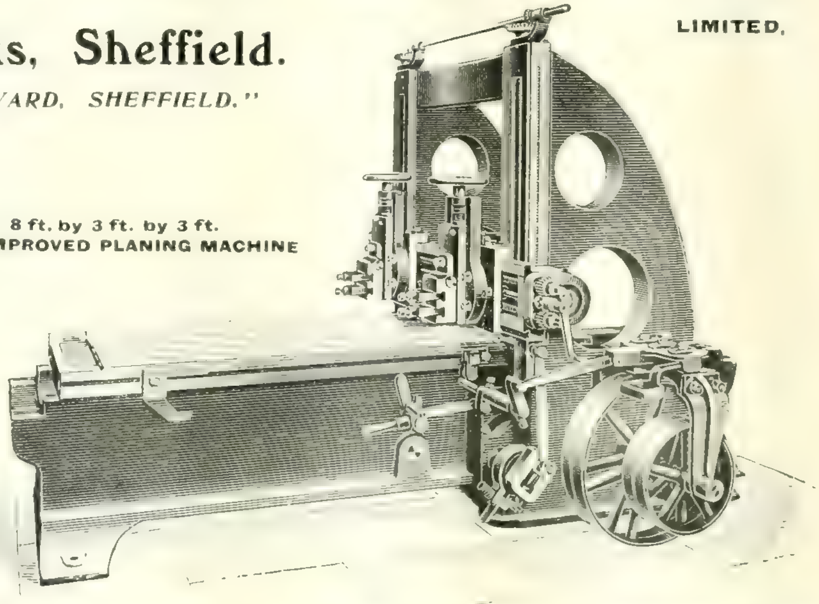

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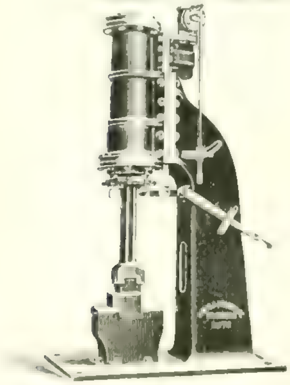

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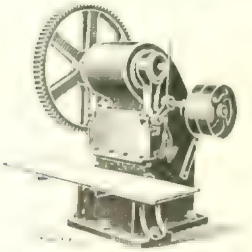

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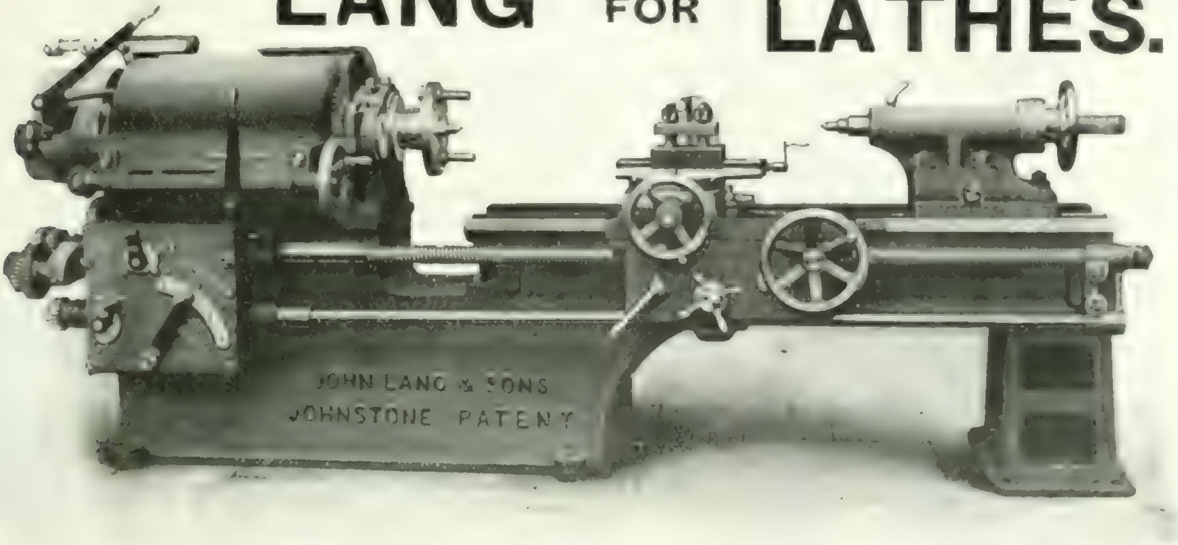

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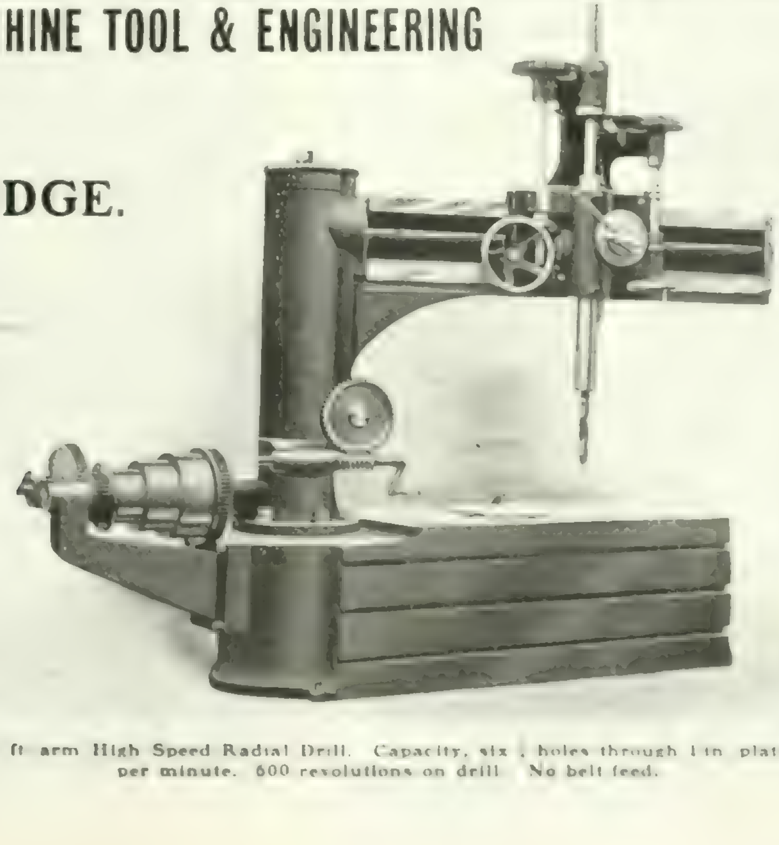

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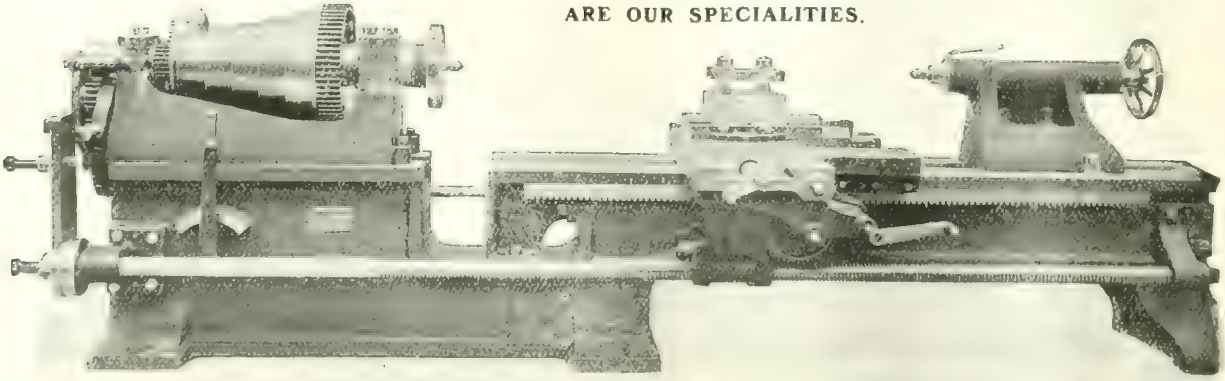

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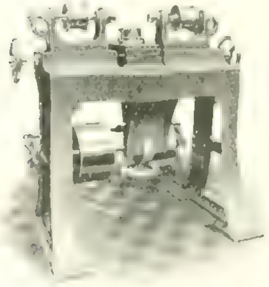

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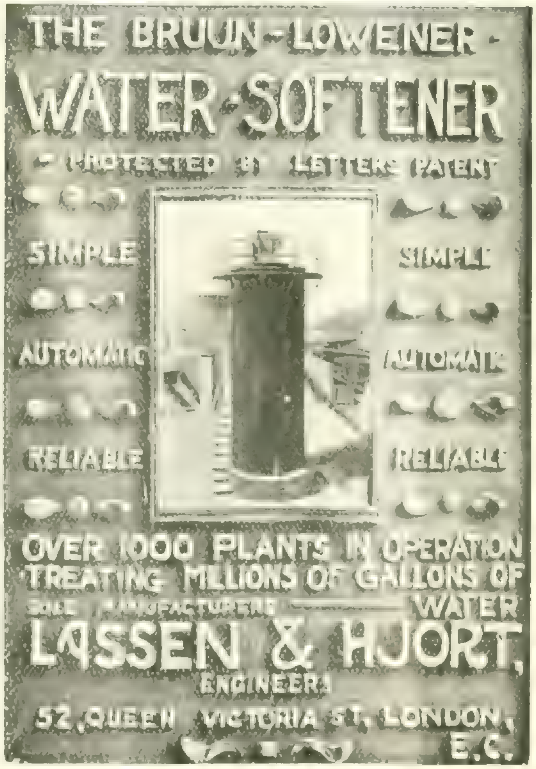

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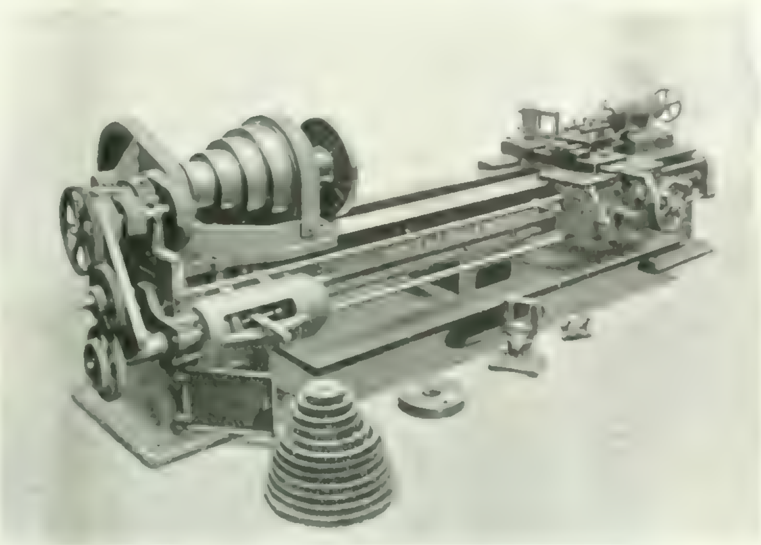

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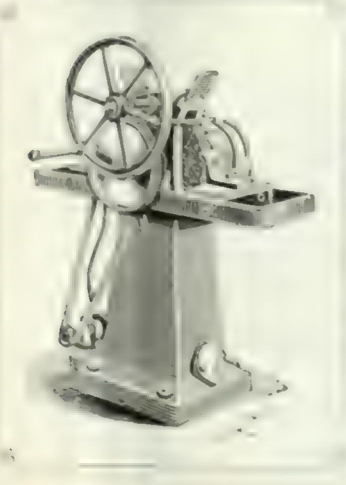

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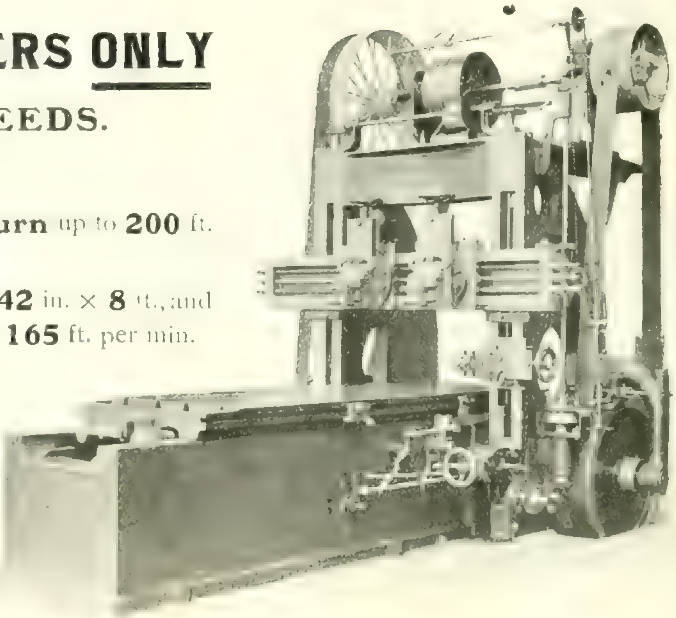

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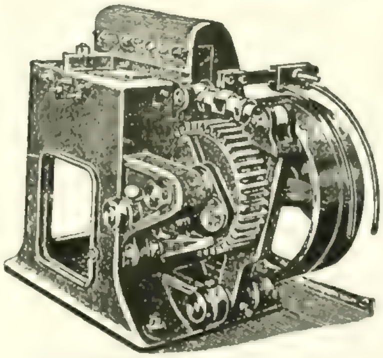

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PAGE'S WEEKLY Machine Tools

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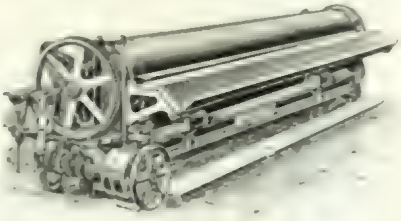
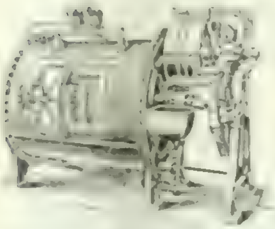
AND COOKING APPARATUS.





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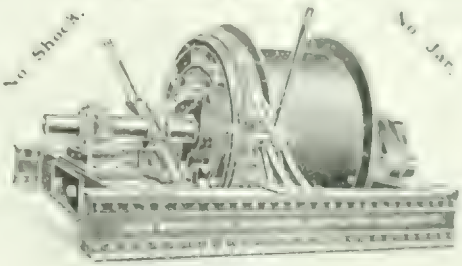

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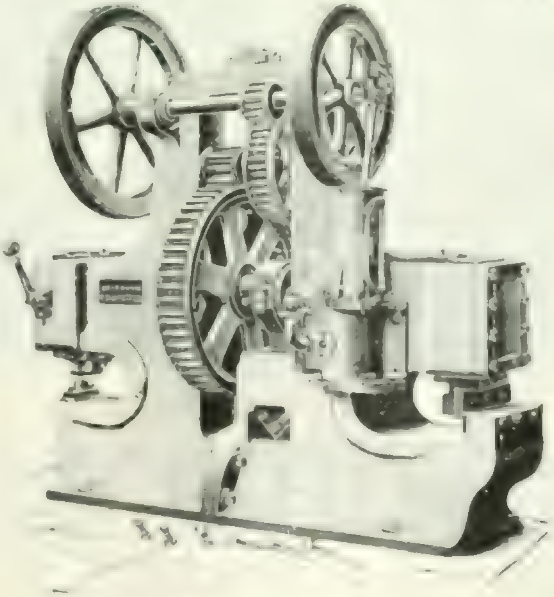

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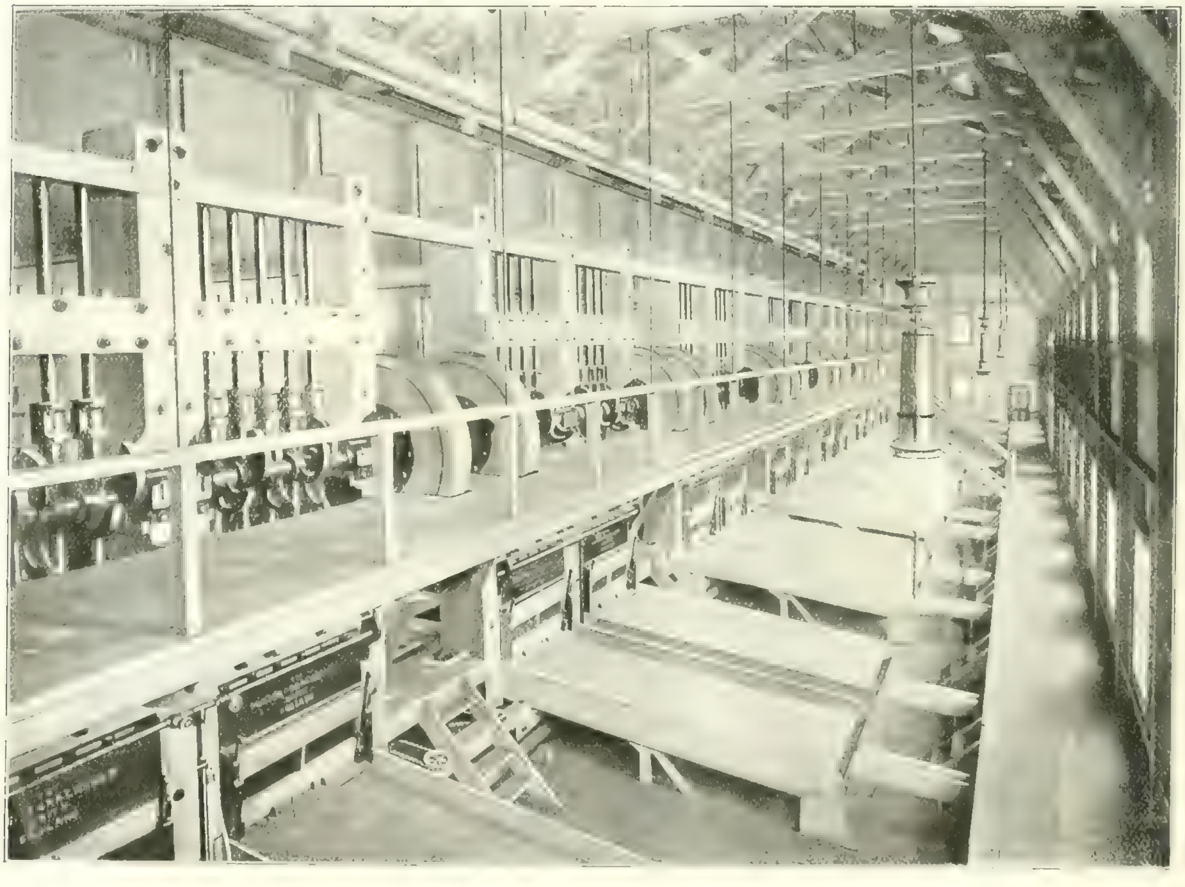

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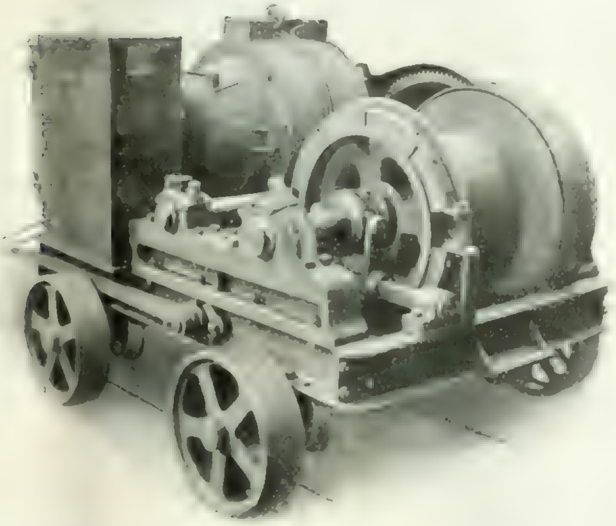

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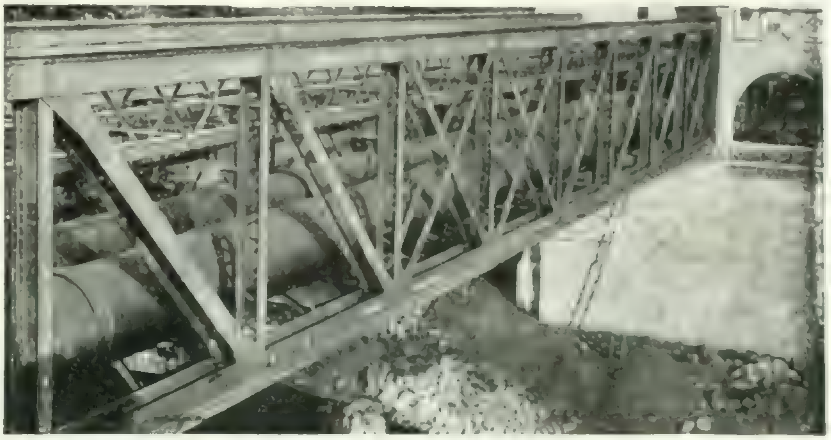

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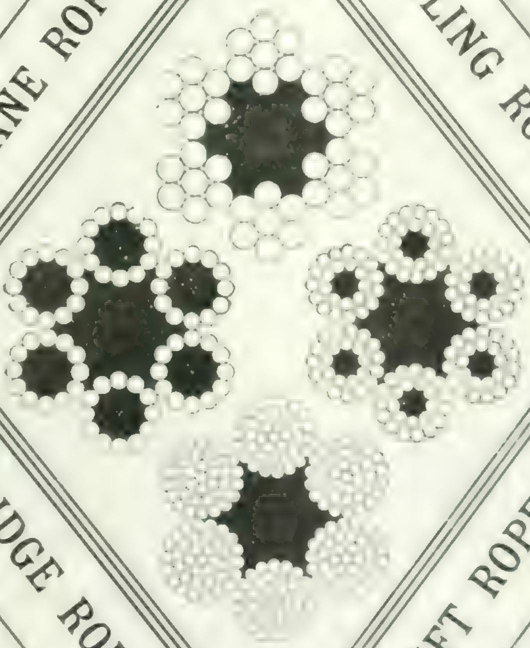

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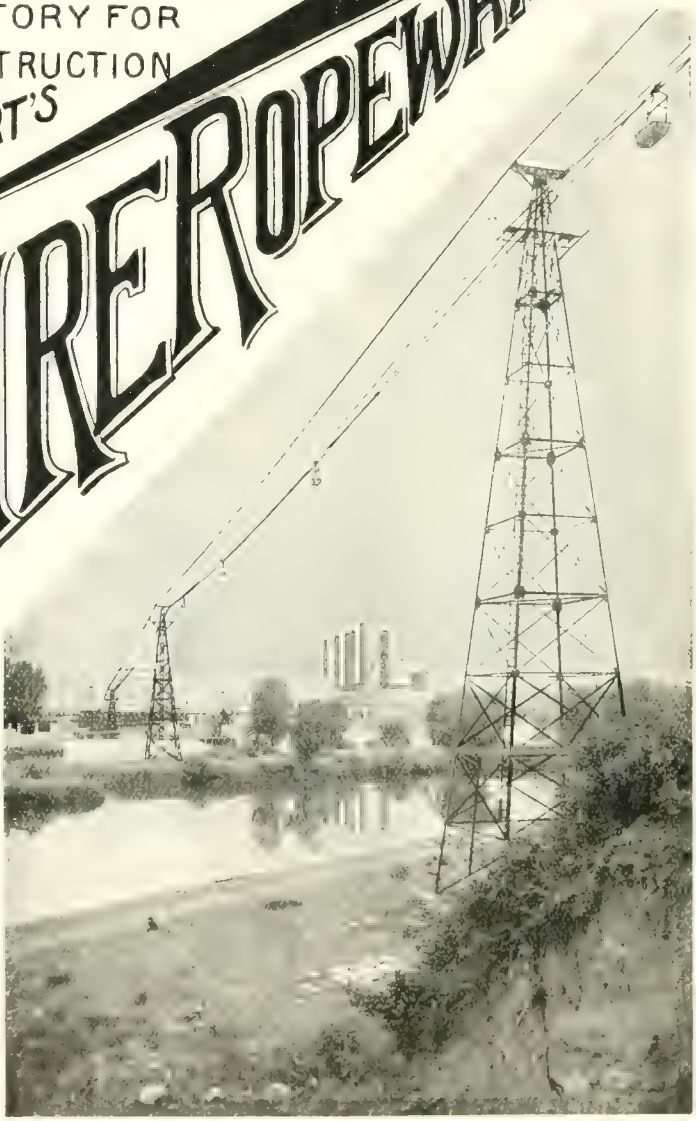

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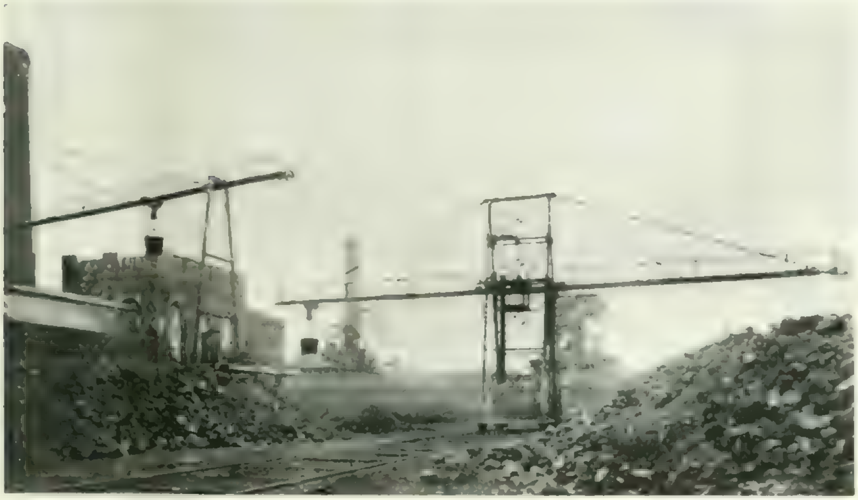

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"The Lancaster"

1903 PATENT (R.T.M.)

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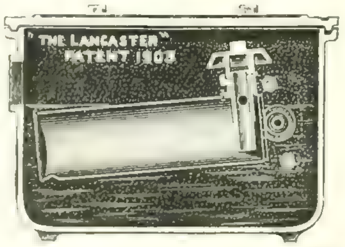

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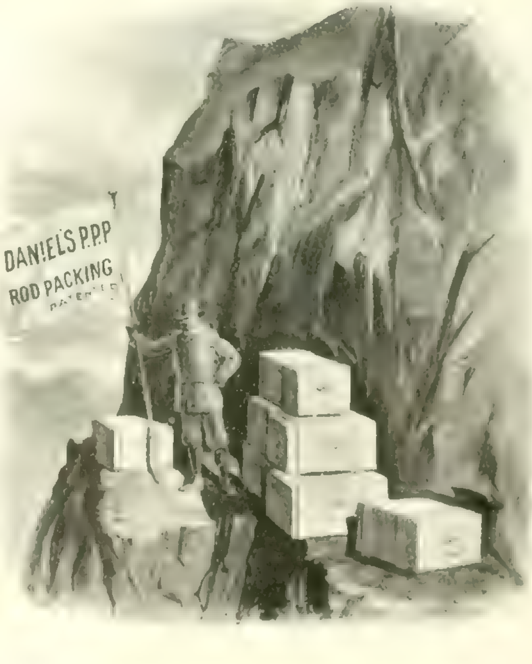

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The Rods last longer;
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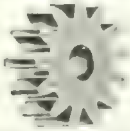
Gearing for all Purposes.

RAW HIDE GEARS AND BLANKS



FOR NOISELESS GEARING

AD. AHLERS
WHITLEY BAY
NEWCASTLE ON TYNE

[illegible]

Metal Gears of all Sorts.

For the information of Readers and Subscribers, we beg to announce that

Page's Weekly

will be published half-yearly, in two volumes, as follows:

[illegible]

[illegible]

[illegible] be published with the last number of the half year.

BOUND COPIES of LAST YEAR'S [illegible]

Half Morocco	**15s**
Green Cloth	**10s 6d.**

[illegible]

W. & O. GILMOUR,
Machine Belt Manufacturers.
St. John's Hill,
EDINBURGH.

[illegible]

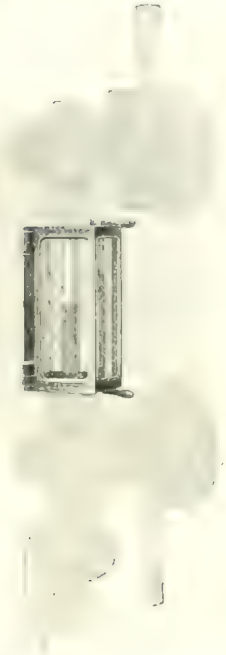
Belting

PURE OAK TANNED LEATHER.

Quality is Our First Consideration.

[illegible] Eighty Years [illegible]

WINN'S PATENT
Reliable Gauge Glass Protectors

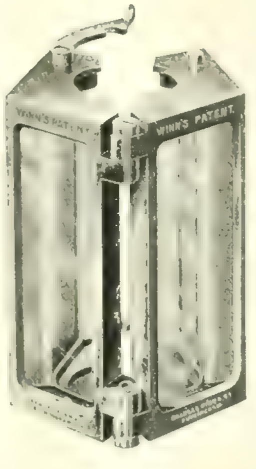


ATTACHED IN A MOMENT

PLATE GLASSES INSTANTLY REMOVABLE BY THUMB CLIPS

CAN BE ATTACHED TO EXISTING GAUGES

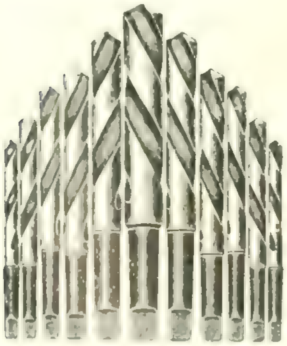
Write for List **D 37** of Water Gauges and Protectors.



CHARLES WINN & Co., Engineers, Birmingham.

RAILS
FISHPLATES, BOLTS, SPIKES, CHAIRS &c
POINTS AND CROSSINGS.
WILLIAM FIRTH L^TD
LEEDS

CARBO-SILICA
(PATENT)
Refractory Bricks and Blocks for
FURNACES
for temperatures
OVER 3,500° Fahr.
E. J. & J. PEARSON LTD.,
STOURBRIDGE.



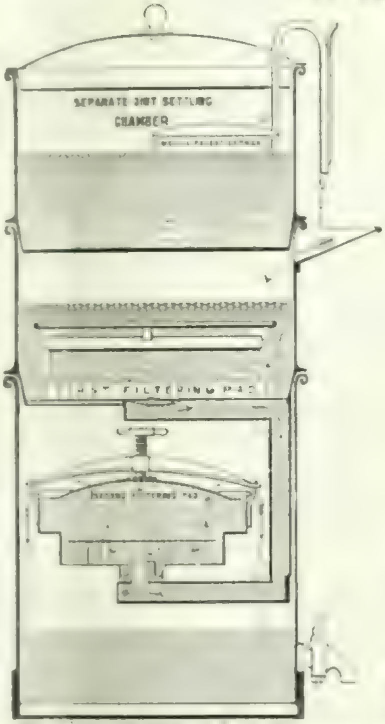
Twist Drills,
Taps,
Milling Cutters,
Reamers.

H. F. SCHNICKE,
CHEMNITZ (Saxony).

PAGE'S WEEKLY — Wells' Specialities

WELLS' PATENT "Waste Oil" FILTERS

FITTED WITH SIGHT-FEED SYPHON.



WELLS' PATENT "WASTE OIL" FILTER

SUPPLIED TO THE PRINCIPAL GOVERNMENTS FOR THE NAVY, DOCKYARDS, &c., AND TO THE LEADING ELECTRIC LIGHT INSTALLATIONS, ENGINEERING WORKS, GAS ENGINE MAKERS, PRINTERS, &c., &c.

OVER **10,000** SOLD.

MONEY SAVERS to any USERS OF MACHINERY.

Pay first cost in a short time, as Dirtied Oil, which has hitherto been thrown away, can be filtered and used again and again.

Write for List of Testimonials and Samples of Work done by the Filter

No. 1.—	[illegible]	35 -
No. 2.—	[illegible]	50 -
No. 3.—	[illegible]	70 -
No. 4.—	[illegible]	110 -
No. 5.—	[illegible]	189 -
No. 6.—	[illegible]	336 -

[illegible] 250 [illegible]

LARGER SIZES MADE TO ORDER.

NO OUTSIDE POWER REQUIRED.

LIME, WHITING, OR COLD WATER PAINTS,

Applied at a speed of from 8 to 10 square yards per minute, in a manner superior to brush work

[illegible]

Will save First Cost in a Few Days.

No. 6.	[illegible]	£7 7s.
No. 4.	[illegible]	£8 10s.
No. 4ᴬ	[illegible] Same capacity as No. 4 Machine	£9 10s.
No. 5.	[illegible]	£10 10s.
No. 5ᴬ	[illegible]	£11 15s.

WELLS' IMPROVED LIMEWASH.

MUCH SUPERIOR TO ORDINARY LIMEWASH. SLAKED WITH WATER. QUICKLY MIXED. WILL NOT RUB OFF. LEAVES A GOOD SURFACE.

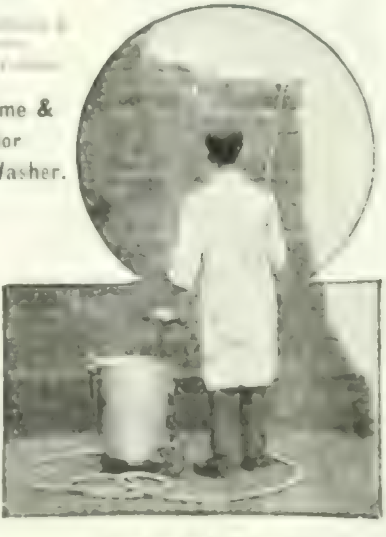
Price 13/8 per cwt., Carriage Paid.

If in lots of 3 cwt. at a time 12/8 per cwt.

WELLS' "LIGHTNING"

[illegible]

Lime & Color Washer.



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A. C. WELLS & Co.,
100a, Midland Road, St. Pancras,
Works: Cheetham, Manchester. LONDON, N.W.

PAGE'S WEEKLY Railways

NORTHERN RAILWAY OF FRANCE

AND

SOUTH EASTERN & CHATHAM RAILWAYS.

FREQUENT and RAPID COMMUNICATION BETWEEN LONDON and PARIS.

SHORTEST SEA PASSAGE

(ONLY ABOUT SIXTY MINUTES).

FIVE QUICK SERVICES DAILY, as under:

Via DOVER AND CALAIS.

Depart from London		Arrive at Paris	Depart from Paris		Arrive at London	
[illegible]	For PARIS [illegible]	[illegible]	[illegible] m.	For Intermediate Stations	[illegible]	Charing Cross Station
Charing Cross Station	For Intermediate Stations	[illegible]	[illegible] m.	For CALAIS [illegible]		
[illegible]	from Victoria Station	[illegible]	[illegible]		[illegible]	Victoria Station
[illegible] p.m.	Paris, Charing Cross Station	[illegible]	[illegible]	Intermediate Stations	[illegible]	Charing Cross Station.

Via FOLKESTONE AND BOULOGNE.

Depart from London		Arrive at Paris	Depart from Paris		Arrive at London	
[illegible]	from Charing Cross Station	[illegible] p.m.	[illegible]	Intermediate Stations	[illegible] m.	Charing Cross Station
[illegible]		[illegible] p.m.	[illegible]		[illegible] m.	
[illegible] p.m.		[illegible] p.m.	[illegible] p.m.	For Boulogne only		

† 1st and 2nd Class only. ‡ 1st, 2nd, and 3rd Class. * Restaurant Car between Paris and Calais or Boulogne, and *vice versa*.

*** First-class Hotel and Restaurant at the Gare du Nord, Paris, and at Calais Maritime Station. Luncheon Baskets obtained at fixed prices.

The 2 20 p.m. departure from Charing Cross is the fastest connection between London and Bâle for Switzerland and Italy, *via* the Gothard Route. Through Corridor Trains and Restaurant and Sleeping Cars.

South Eastern & Chatham Railway.

THE CONTINENT

Four Royal Mail Routes

VIA

DOVER CALAIS.	FOLKESTONE BOULOGNE.	DOVER OSTEND.	QUEENBORO FLUSHING.

LONDON-PARIS IN LESS THAN SEVEN HOURS.

Five Services Daily in Each Direction.

NEW EXPRESS AFTERNOON DINING CAR SERVICE

Daily (Sundays included) via FOLKESTONE and BOULOGNE.

	P.M.		P.M.
CHARING CROSS	2.20	PARIS	4.0
PARIS	9.15	CHARING CROSS	10.45

Mail Route *via* Dover and Ostend.

Three Express Services Daily in Each Direction.

Flushing Royal Mail Route to Germany, etc.

Two Services Daily in Each Direction.

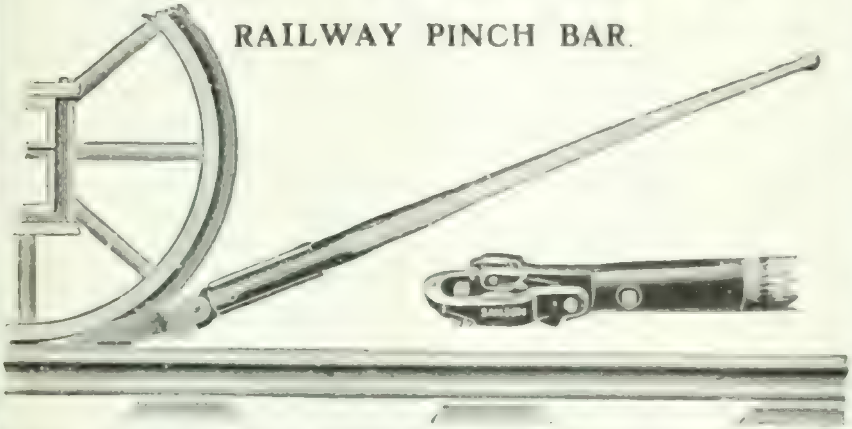
For Full Particulars see S.E. & C.R. Continental Time Tables, price 3d.

VINCENT W. HILL, *General Manager.*

PAGE'S WEEKLY Railway Pinch Bars

The "SAMSON."

RAILWAY PINCH BAR.



A Few of the Users of the "Samson" Pinch Bars:—

Cambrian Railways.
Cork, Bandon & South Coast Railway Co.
Donegal Railway Co.
Great Northern Railway Co.
Great Southern and Western Railway Co.
London and North Western Railway Co.
Midland Railway Co.
Midland Railway Co., N.C. Committee.
Bolckow Vaughan & Co.'s Collieries.
Grassmoor Collieries.
Garforth Collieries.
Henry Briggs, Son & Co. Ltd
Hoyland Silkstone Collieries.
Houghton Main Collieries
J. & G. Wells' Eckington Collieries
Micklefield Coal and Lime Co
Mitchell Main Collieries.
Shireoaks Collieries.
Sheepbridge Co. Iron and Steel Works
Staveley Iron and Coal Co.

The "Samson" Pinch Bar

Is used as a great labour-saving tool where wagons or locomotives require moving short distances.

OUR OFFER:—

SPECIMEN BAR SENT ON SEVEN DAYS' FREE TRIAL, CARRIAGE PAID BOTH WAYS

SAMSON & CO.,

Garforth, near LEEDS.

PAGE'S WEEKLY Systems for Engineers

Card Systems are a Business Necessity

COSTS.

The cost of production is an important feature in the counting house of every manufacturing concern, as charges and future estimates must be based on the record of such costs. Card systems, properly applied, give all this information with a minimum of clerical labour and a maximum of convenience that cannot be obtained with a book system, no matter how well devised. All the details being accessable at any time, without respect to each other, so that statistics of any kind may be gathered without difficulty or delay, using in many instances the original record and dispensing with the necessity of transcribing same.

QUOTATIONS—In and Out.

When a client refers to a quotation without indicating the date it was given, or if, when buying, it is desirable to consult quotations received, considerable difficulty is often experienced in locating the particular information desired. The card system will overcome this difficulty. By a method of cross-indexing the knowledge may be obtained either by date, name of article, or the name of the firm interested.

TRAVELLERS' RECORDS.

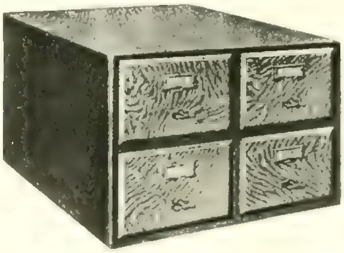
To supplement a traveller's efforts so as to help him to get all there is in his territory you must know what he is doing, who he calls on, when he is to call again, with any other details of interest. This information also enables the firm to keep in closer touch with their customers, to know if anyone is being neglected, and a new traveller can take up the work intelligently and without prejudice to his employer's interests.

STAFF RECORDS.

It is always desirable to know whom the staff consist of; where they live, where they came from, who they worked for, and various other details, for and against, of interest to their employers. The card system is particularly applicable to this purpose, as names can be filed in strict alphabetical order and are readily referred to. When anyone leaves, the name can be transferred to the past employees' file, without rewriting or scratching out the previous record, where it is accessable for reference in case of reapplication for a position or other purpose.

THIS CABINET

Properly and intelligently arranged, will contain all that information regarding the details



pertaining to a business organization which it is necessary to have accessable to that guiding hand that is to direct it on to continued success.

OVERDUE ACCOUNTS

Are the bane of the manager and the cashier, the great difficulty being to dun the slow paying accounts without hurting the feelings of an otherwise good customer. This can be successfully accomplished by the use of the card index system, with the additional advantage of having all overdue accounts together and under the eye of the man responsible for their collection. One of our clients has reduced his outstanding accounts £10,000 per year by its use, and states that the system is responsible for increased purchases by these clients. We can show how.

CATALOGUE INDEXES.

Can you always place your hand on the particular catalogue, circular or sample sheet you want when it becomes necessary to consult same? The answer to that question is usually "No, but—." The card system will enable you to refer directly to the particular catalogue or catalogues you require, and even to the page, either by name of the firm issuing or by the article treated. The firm cards can also contain information regarding forwarding, discounts, etc.

FOLLOW-UP SYSTEMS.

How frequently orders are lost through inadequate attention is best shown by the experience of one of our clients, who stated that they secured 25% better results from their advertising through the use of the card follow-up system than they had formally secured without it. We can apply this system to your needs so that you will derive equal benefits, whether you secure your business through advertising, circularizing or by traveller.

GOODS ORDERED.

How often goods are ordered in anticipation of early use, and delivery is promised at a certain date; through lack of a proper system the date of delivery lapses without attention from the purchaser and when the goods are wanted it is found, to the inconvenience of everybody concerned, and sometimes to the financial loss of the firm, that no delivery has been made. A very simple application of the card system will overcome this difficulty and enable the user to prevent any such delays, besides permitting him to keep in closer touch with his receiving department.

ROCKWELL-WABASH Cº Lᵀᴰ 69 Milton St., LONDON, E.C.
50 DEANSGATE ARCADE, MANCHESTER. 167 BUCHANAN ST., GLASGOW.

PAGE'S WEEKLY Ventilation, &c.

"SIROCCO" FANS

"Sirocco" Induced Draft Fans are now in use at the following Electricity Stations:—

Bedford.
Brisbane.
Bury.
Crewe.
Glasgow (Port Dundas).
Greenock.
Hanley.
[illegible]
London (Fulham).
Do. [illegible]
Do. [illegible]
Do. [illegible]
Newcastle on Tyne [illegible]
Do. (Carville Station).
Portsmouth.
Rothesay.
South Lancashire Tramways.
Stockport.
Sunderland.
Watford.
York.

[illegible] "Sirocco" Induced Draft [illegible] at Port Dundas Electric Light Station.

FOR

INDUCED DRAFT.

"[illegible] good draft in a brick chimney."

Highest Award, Grand Prize, St. Louis Exposition, 1904

Davidson & Co., LTD.,

"Sirocco" Engineering Works,

BELFAST.

Branches at London, Manchester, Glasgow, Calcutta, Colombo, &c.

Boltons' Downtake Superheater WITH DOUBLE CIRCULATION.

IMPROVED BOX AND "FIELD" TUBES. [illegible]

Simple and Reliable. Readily Applied. Inexpensive.

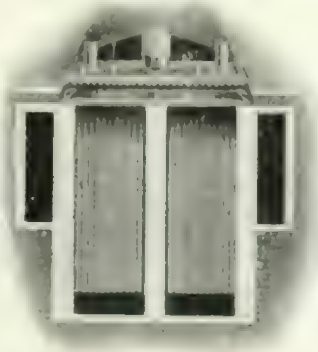
Saves 10 to 15 %.

Is made of Steel throughout.

A large number working in—
Textile Mills,
Paper Works,
[illegible]
Electricity Stations,
Flour Mills, etc.

Suitable for any Working Pressure up to 200 lbs. per square inch.

Approved of by Leading Engineers and Insurance Co.'s.



REPEAT ORDERS BEING GIVEN.

PATENTEES AND SOLE MAKERS—

A. BOLTON & CO.,

Engineers and Superheating Specialists.

49, Deansgate, MANCHESTER.

JOHN GIBBS & SON

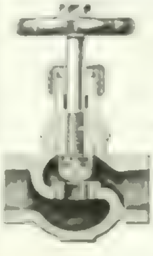
Ventilating Engineers,

80, JUKE STREET,
LIVERPOOL.

Say Advertising does not pay,

SEE OUR ILLUSTRATED ADVERTISEMENT NEXT WEEK.

The "SHAW" Patent Steam Valves . .



With Renewable Seats, Interchangeable Concentric Valve, Compound Packing to Spindle, Special Metal, and High-Class Workmanship.

[illegible]

Try Them! Sent on Approval.

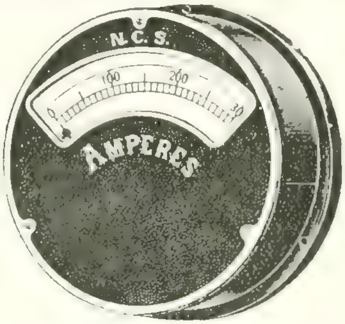
☞ [illegible]

JOSEPH SHAW, B Dept., Albert Works, HUDDERSFIELD

PAGE'S WEEKLY Miscellaneous

NALDER BROS. & THOMPSON, LTD.
Managing Director: F. H. NALDER.

Ammeters, Voltmeters, Recorders, Circuit Breakers, Switchboards.



Telegrams: "OCCLUDE, LONDON."

Telephone No. 124 & 6124 BANK.

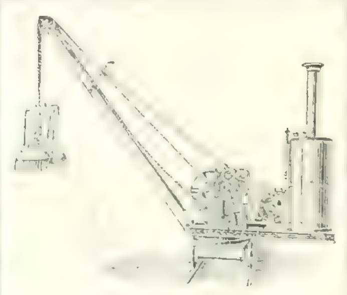
Moving Coil Instruments, from £3 3s. (list).

34, QUEEN STREET, LONDON, E.C.

Agents:

BEERS, SKINNER & Co., [illegible] King Street, Manchester: WM. McGEOCH AND Co., Ltd., Mercantile Chambers, [illegible] Argyle Street, Glasgow: VANDAM, MARSH AND Co., Ltd., [illegible] Upper Priory, Birmingham: ROBERT BOWRAN & Co., 3, St. Nicholas Buildings, Newcastle-on-Tyne: ERNEST ROBERTS, 6, Holborn Place, London, W.C.: LUCIEN ESPIR [illegible], Rue de Maubeuge, Paris: OSWALD HAES, 56, Margaret Street, Sydney, N.S.W.: BALMER LAWRIE AND Co., Calcutta: STUDIO ELETTROTECNICO INDUSTRIALE, Lugano and Milan (for Switzerland and Italy)

OIL MILLS & FEEDING CAKE MILLS
of latest & most up-to-date type.
GRAB DREDGERS & EXCAVATORS
HYDRAULIC LEATHER PACKINGS.



"Kingston" Patent Grab-Dredger.

ROSE, DOWNS & THOMPSON, LTD
OLD FOUNDRY, HULL and
12, Mark Lane, LONDON, E.C.

FRIED. KRUPP A.-G. GRUSONWERK, Magdeburg-Buckau.

Complete Machinery for **CEMENT WORKS**
Fire Brick Factories, Phosphate Mills,
Manure Works, Artificial Stone Factories.

Sole Representative for Great Britain and Ireland: **W. STAMM,** 25, College Hill, Cannon Street, LONDON, E.C.

HIGH-CLASS LUBRICANTS FOR MACHINERY OF EVERY DESCRIPTION.

LAND and MARINE ENGINE and CYLINDER OILS.
DYNAMO and GAS ENGINE OILS.
CRANK CHAMBER and STEAM TURBINE OILS.
MOTOR and CYCLE OILS.
SOLIDIFIED OILS and GREASES for all PURPOSES.

BLUMANN & STERN, LTD., Plough Bridge, Deptford, LONDON, S.E.
Contractors to H.M. Government, Home and Foreign Railways, &c.

Index to Advertisers.

Advertisements not appearing this week will be found by reference to the preceding or following issues, with the exception of those appearing monthly

PAGE
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
Anderson, & Son, Ltd., D.
Askham Bros. & Wilson, Ltd. 60
[illegible]
[illegible]

[illegible]
[illegible] 59
Barns, W., & Son Outside Back Cover
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
Blenkhart, A., & Co. ... ...
[illegible]
Bolton, A., & Co. ...
[illegible]
[illegible]
[illegible]
[illegible]

PAGE
[illegible]
[illegible]
[illegible]
Britannia Engineering Co., Ltd.
British Steam Specialties, Ltd. ...
[illegible]
[illegible]
Brown Hoisting Machinery Co.
Bruce Peebles & Co., Ltd.
Brush Electrical Engineering Co.
Buckley, Samuel ... ...
[illegible]
Burton, C. W., Griffiths & Co.
[illegible]

[illegible] Inside Back Cover
Capell Fan Co.
Churchill, Charles, & Co., Ltd. ...
Clarke's Crank & Forge Co., Ltd
Clayton, Son & Co., Ltd....
Cochran & Co. (Annan) ...
Concentric Condensers, Ltd.
Consett Iron Co., Ltd. ...
Crompton & Co., Ltd.
[illegible]
[illegible]
Cunliffe & Croom, Ltd

HENRY BERRY & CO., Ltd.,
Croydon Works, LEEDS.

Specialities: **HYDRAULIC MACHINERY & ELECTRIC CRANES.**

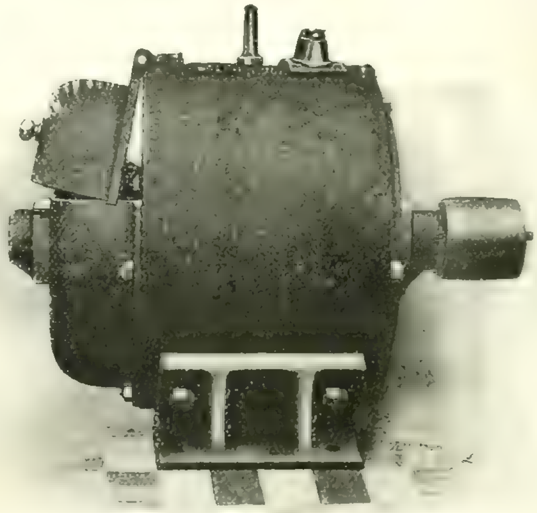
60 Tons Three-Motor Electric Crane.

PRICES, PARTICULARS, AND LISTS ON APPLICATION.

PAGE'S WEEKLY Electrical Apparatus

MATTHEWS & YATES, LTD.

Swinton, MANCHESTER.

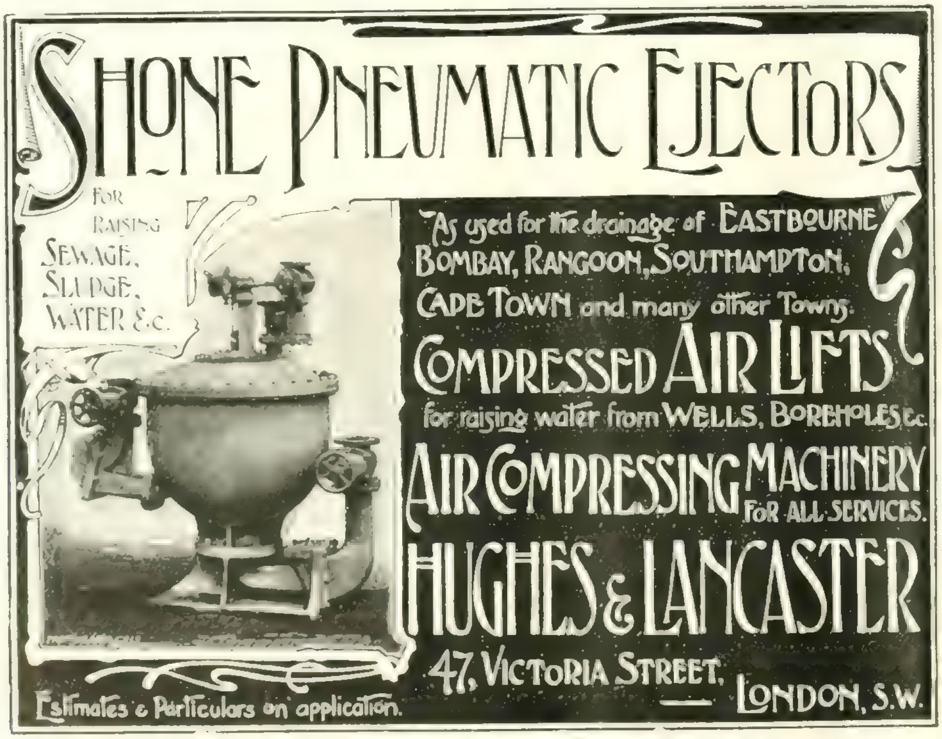


Electric Motors

Fully & Semi-Enclosed
¼ to 20 B.H.P.

SEND FOR CATALOGUE OF OUR OTHER SPECIALITIES.

LONDON: 84, Gray's Inn Road.
GLASGOW: 144, St. Vincent Street.
LEEDS:
Standard Buildings, City Square.



SHONE PNEUMATIC EJECTORS

FOR RAISING
SEWAGE,
SLUDGE,
WATER &c.

"As used for the drainage of EASTBOURNE,
BOMBAY, RANGOON, SOUTHAMPTON,
CAPE TOWN and many other Towns.

COMPRESSED AIR LIFTS

for raising water from WELLS, BOREHOLES &c.

AIR COMPRESSING MACHINERY

FOR ALL SERVICES.

HUGHES & LANCASTER

47, VICTORIA STREET,
LONDON, S.W.

Estimates & Particulars on application.

Index to Advertisers—(Contd.)

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
Drum Engineering Co. ... ... [illegible]

[illegible]
[illegible]
Empire Typewriter Co.... [illegible]
[illegible]
[illegible]

[illegible]
Fairbanks, Morse & Co.... [illegible]
Fairley, James, & Sons ... [illegible] Cover
Farnley Iron Co., Ltd. ... ... [illegible]
Findlay, Alex. & Co., Ltd. [illegible]
[illegible]
Fleming, Birkby & Goodall, Ltd [illegible]
Fowler, John, & Co. (Leeds), Ltd. [illegible]
Fraser & Chalmers, Ltd.... ... [illegible]
[illegible]

[illegible]
Gent & Co., Ltd. .. [illegible]
[illegible] 41
Gilkes, G., & Co., Ltd. 11
[illegible] 35
[illegible]
Graham, Morton & Co., Ltd. ... [illegible]
Grantham Crank and Iron Co. ... [illegible]
Green, E., & Son, Ltd. ... Inside Back Cover
Greenwood & Batley, Ltd 78
Griffin, Charles & Co., Ltd 11

Hadfield's Steel Foundry Co., Ltd [illegible]
Halden, J., & Co. ... [illegible]
Hall, B. J., & Co. [illegible]
[illegible]
Hamilton, J. B., & Co. 3
[illegible]
Hasenclever Sohne, C. W. [illegible]
[illegible]
Hartley & Sugden, Ltd. ... [illegible]
Hathorn, Davey & Co., Ltd [illegible]
Head, Wrightson & Co., Ltd. [illegible]
[illegible]
Horsfall Destructor Co. ... ... [illegible]
Howard Bros. ... ... [illegible]
Howes, S., & Co. ... ... [illegible]
Hudswell, Clarke & Co., Ltd. [illegible]
Hughes & Lancaster ... ... [illegible]
[illegible] G. H. 3
Humbolt Engineering Works Co.
Hunslet Engine Co. ... ... [illegible]

India Rubber, Gutta Percha, and Telegraph Works Co., Ltd. ... ... Outside Back Cover

Jones & Lamson Machine Co. 3

Keep, Juxon & Co. [illegible]
Keith, J., & Blackman Co., Ltd. [illegible]
Klinger, Richard & Co. ... .. [illegible]
Krupp, Fried. ... . [illegible]

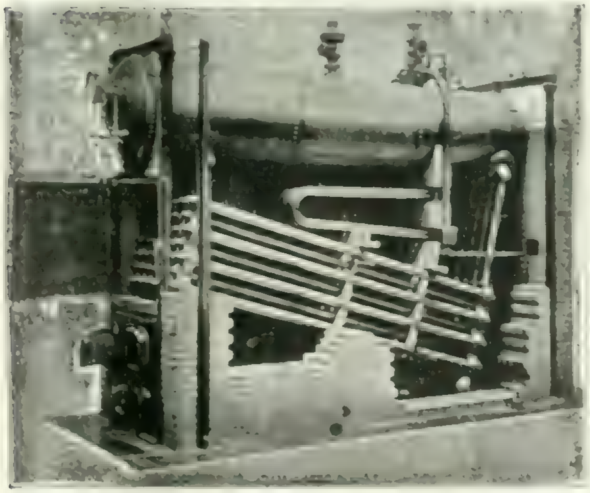
Lancaster & Tonge, Ltd. 34
[illegible]
Lassen & Hjort ... . [illegible]
Leckenby, Benton & Co. [illegible]
Leeds Forge Co., Ltd. ... .. [illegible]
[illegible]

BABCOCK & WILCOX Ltd., Engineers and Manufacturers of

Patent Water-Tube Boilers.

OVER 4,700,000 H.P. IN USE IN ALL INDUSTRIES.

[illegible] GRAND PRIX
[illegible]



[illegible]

Complete Installations of Steam
Piping and Boiler House Plants,

ALSO

WATER-TUBE MARINE BOILERS.

[illegible]

Head Offices:
LONDON: Oriel House, Farringdon St.,
E.C.; and Branches.

[illegible] Engineers and Steam Users.

WORKS: RENFREW, SCOTLAND.

Index to Advertisers—(Contd.)

	PAGE
Luke and Spencer, Ltd.	23
Lyle Co., Ltd.	83
Mabie, Todd & Bard	86
Magnesia Coverings Ltd.	
Magnolia Anti-Friction Metal Co., Ltd.	40
Marion & Co., Ltd.	
Mason, W. F., Ltd.	63
Mather & Platt, Ltd.	
Matthews & Yates, Ltd	44
Meldrum Bros., Ltd.	60
Metallic Paint Co., Ltd.	22
Miller, Hy., & Co.	50
Mirrlees Watson Co., Ltd.	56
Mix & Genest	47
Nalder Bros., & Thompson	42
New Anglo-American Machine Brush Syndicate	—
New Zealand Mines Record	
Newton Bros.	16
Nicholson Tool Co.	
Niles-Bement-Pond Co.	13
Noble & Lund, Ltd.	23
Northern Engineering Co., 1900, Ltd.	16
Northern Railway of France	38
Nye, Arthur W.	
Page & Rowlingson	3
Parker Foundry Co.	
Parkinson, J., & Son	11
Partridge & Cooper, Ltd.	
Pearson, E. J. & J.	36
Peebles, Bruce & Co., Ltd.	
Pegg, S., & Son	17
Perham, H. W., Ltd.	[illegible]
Phœnix Dynamo Mfg. Co.	79
Phosphor Bronze Co., Ltd.	29
Piggott, Thos., & Co., Ltd.	26
Positive Rotary Pumps, Ltd.	65
Power-Gas Corporation, Ltd.	
Pratt & Whitney Co.	—
Premier Boiler Tubes, Ltd.	—
Pryor, Edward, & Son	61
Purdon & Son, John	—
Quaker City Rubber Co.	34
Recorders, Ltd.	81
Redfern, S., & Co.	—
Redman, C., & Sons	22
Reliance Lubricating Oil Co.	—
Renshaw, W. R., & Co., Ltd.	58
Rice & Co. (Leeds), Ltd.	18
Richardsons, Westgarth & Co., Ltd.	—
Richter, Gustav	76
Riter-Conley Mfg. Co.	—
Robinson, T. D. & Co., Ltd.	74
Rockwell-Wabash Co., Ltd.	40
Roller, A.	Inside Front Cover
Rose, Downs & Thompson, Ltd.	42
Rossendale Belting Co., Ltd.	—
Rubber Stamp Co.	86
Ryder, William, Ltd.	—
St. Helen's Cable Co., Ltd.	58
Samson & Co.	30
Sankey, J. H., & Son	Inside Front Cover
Schieren, Chas. A. & Co.	
Scotch & Irish Oxygen Co., Ltd.	48
Scott, Walter, Ltd.	73
Schmicke, H. F.	36

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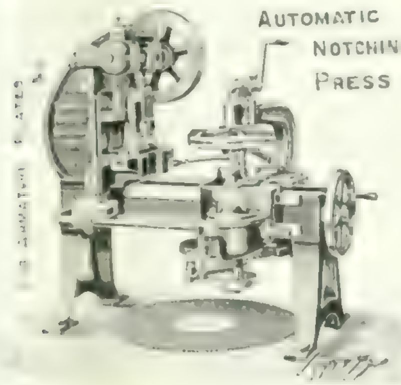

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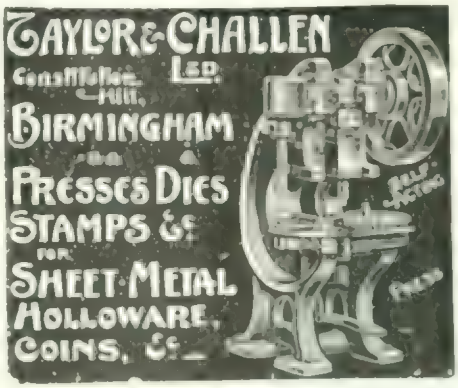

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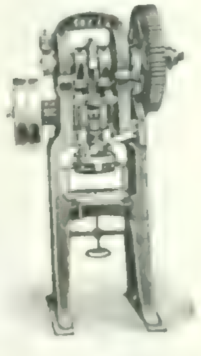

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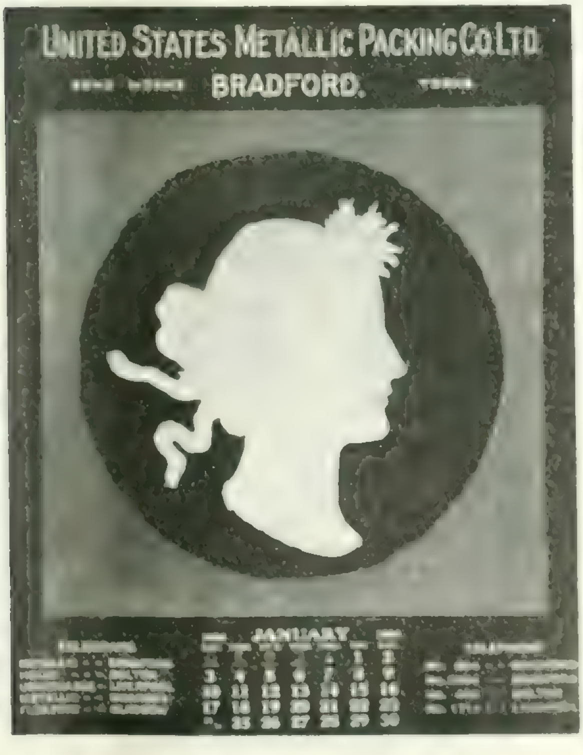

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Index to Advertisers—(Contd.)

	PAGE
Shannon, Ltd.	84
Shaw, Joseph	41
Simplex Steel Conduit Co., Ltd.	48
Smith, Eric & S. A.	3
Smith, G. F., Ltd.	20
Smith's Stamping Works, Ltd.	72
Smith, Thomas & Sons, of Saltley, Ltd.	60
Soest, L. & Co., Ltd.	64
South Eastern & Chatham Ry.	38
Southwood, Smith & Co., Ltd.	87
Spon, E. & F. N.	3
Spottiswoode & Co., Ltd.	—
Stamm, W.	42
Stirk, John, & Sons	19
Stirling Boiler Co., Ltd.	53
Stone, J, B. & Co.	33
Sturtevant Engineering Co., Ltd.	51
Suddeutsche Kabelwerke, A. G.	61
Summerscales, W., & Sons, Ltd.	25
Swain, John & Son, Ltd.	83
Tangyes Ltd.	67
Taylor & Challen, Ltd.	47
Temperley Transporter Co.	33
Thom, John Z.	Inside Front Cover
Thompson & Co., Gilbert	73
Thompson, John	3
Thornycroft, John I., & Co., Ltd.	
Titan Binder Co.	86
Trading and Manufacturing Co., Ltd.	82

	PAGE
Treasure, J. B., & Co.	-
Tubes, Ltd.	28
Turner, Atherton & Co.	78
United Kingdom Self-Adjusting Anti-Friction Metallic Packing Syndicate, Ltd.	—
United States Metallic Packing Co., Ltd.	47
Von der Heyde, J. Bennett	
Ward, H. W., & Co.	23
Ward, T. W.	20
Waygood & Co., Ltd.	74
Weaver, B., & Co.	59
Weise & Monski	66
Wells, A. C., & Co.	37
Wells & Co., M.	—
West & Co., H. J.	51
West Hydraulic Engineering Co.	12
Whitman & Barnes Manufacturing Co.	—
Wild, M. B., & Co.	27
Williams, J. H., & Co.	68
Winn, Charles, & Co.	36
Woodhouse & Rixson	—
"Woodite" Co.	70
Wrigley, E. G., & Co., Ltd.	50
Yorkshire Patent Steam Wagon Co.	
Yorkshire Machine Tool and Engineering Works	21
Yost Typewriter Co.	—

The
Scotch & Irish Oxygen Co., Ltd.,
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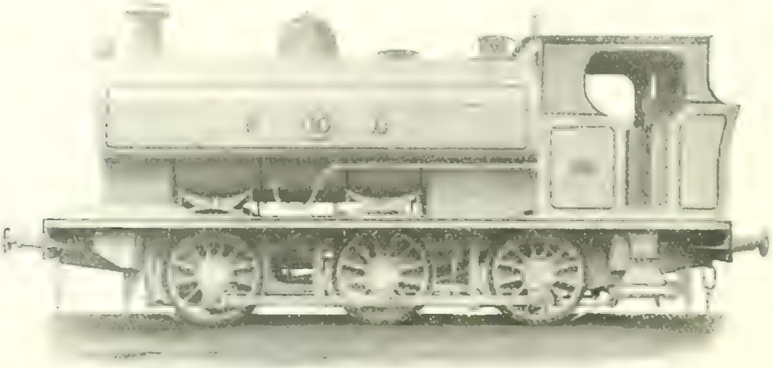

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PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VI. LONDON, FRIDAY, JANUARY [illegible] No. 10.

The Offices of "Page's Weekly,"
Wednesday, Midnight.

IN my last notes I incidentally mentioned in fact that a layer of grease upon the water side of the heating surface was "far worse" than the deposit of ordinary scale. From one or two inquiries which have reached me in consequence, I am induced to devote a little space to the amplification of this statement, which is indeed of much importance to users of feed [illegible] heaters in which the [illegible] is in actual contact with the water to be heated. The experiments of M. Hirsch upon the varying rates of transmission through plates and tubes under different conditions throw much light upon a subject to which I am convinced that we pay too little attention. The transmission through the metal, and from the metal to the water, takes place very readily, so that with a very small difference between the temperature of the iron and that of the water [illegible] large quantities freely, always providing that there are no thick incrustations of scale or coatings of oily matters. With clean plates, when the temperature of the water rises in any boiler, the difference between plate and water does not increase in proportion. Thus, in an iron firebox with plates of three-eighths of an inch in thickness, the water being at 356 deg. F., and evaporating at the rate of 40 pounds per square foot of surface per hour, the difference of temperature between plate and water should be theoretically 212 deg. F, but the temperature of the iron plates never reaches 568 deg. M. Hirsch satisfied himself that, providing only the metal be sound and in direct contact with the water, there is no danger of overheating whatever may be the rate of evaporation. It is far otherwise, however, when the interior surfaces are coated with a [illegible] grease. It

[illegible]

[illegible]

means of fusible plugs of alloys having different melting points disposed over the surface of the plates under experiment, he was able to estimate the temperature of the plate under the varying conditions.

In his inquiries into the effects of a coating of grease, he began by covering the interior surface of the plate with mineral oil, which was then wiped off, leaving a greasy layer of inappreciable thickness, but sufficient to prevent the actual contact of water. Using distilled water he found that even with very moderate heating, the exterior surface of the plate reached temperatures considerably higher than when the surface was clean. Thus, with an evaporation of thirty pounds per square foot per hour, the plate was overheated 122 deg. F.; and with an evaporation of fifty pounds per square foot 176 deg., the temperature of the fire side of the plate being 392 deg. above that of the water. Other experiments tended to show that with very moderate rates of evaporation the temperature of the plate had been not less than 842 deg. F. for the greater part of its thickness.

[illegible] EXPERIMENT.

[illegible] described on page 11[illegible]. The [illegible] shows the appearance of the [illegible] deposited on the point and sides of the jar.

" A great change takes place in all descriptions of iron and mild steel at a temperature of about 630 deg. F., and they either become weak, or so brittle as to be easily broken by a sudden stress or blow, without bending." This sentence, quoted from Hutton, needs no amplification in connection with the results given above.

The effect of a deposit of grease upon the crown-plate of a locomotive firebox made of steel plates has, within my own experience, resulted in the bulging downwards of the plate in a series of pockets between the bolt-stays; a sufficiently disconcerting sight with an incandescent mass of fire 10 in. or 12 in. thick in full swing, and a steam pressure within of 160 lb. per square inch.

M. Hirsch imitated the black patches of partly decomposed fatty matter found adhering to boiler plates by greasing the bottom of a tinned saucepan with mineral lubricating oil and heating it over a slow fire without water. The bottom was then found to be covered with a black coating, to which water would not adhere. The saucepan was then filled with water and heated over the furnace. After boiling for one minute, part of the bottom of the saucepan was seen to become red hot, and this soon spread over the whole of the area exposed to the heat of the furnace. Evidently the bottom of the saucepan was never wetted, and the water assumed the spheroidal condition. This experiment was repeated several times with different intensities of fire, and it was found that with heat corresponding to an evaporation of about 54 lb. per hour, the colour of the bottom was a bright orange red.

Flaws or laminations in firebox and furnace plates are also very liable to give rise to local overheating. With an artificially laminated plate, temperatures beyond [illegible] deg. F. were attained with a rate of evaporation equal to 50 lb. per square foot per hour. On the other hand, properly fitted lap rivet-joints, with the two surfaces in actual metallic contact, transmitted the heat equally, as a single plate of thickness equal to the two plates forming the lap-joint would have done ; except when the evaporation was pushed to 60 lb. per square foot of heating surface, when the temperature of the plate next the fire was found to be over [illegible] deg. F.

There are, of course, several different types of feed-water filters claiming to efficiently separate the oil which comes over with the exhaust steam when this is mixed with the feed water ; but prevention is better than cure, and feed-water heaters, where the exhaust steam is on one side of the tubes, and the water to be heated on the other, are safer, and, in my opinion, preferable in every way, where circumstances admit of their being used.

Being assured that many of my readers would welcome some further details of the apparatus by which Sir Oliver Lodge seeks to dispel fog, I wrote that gentleman on the subject and was courteously referred by him to an article by his assistant which recently appeared in The World's Work. Sir Oliver also placed at our disposal the accompanying photographs. According to our contemporary he "rediscovered in 1884 the fact that by discharging electricity into a smoky or dusty atmosphere, the small particles of which the smoke is composed tend to coalesce into flakes, in the space around the points of discharge, and to be deposited on all opposing surfaces." This tendency as applied to the dispersal of fog is illustrated in a laboratory experiment, a large glass bell-jar being used to contain the artificially-produced fog, while a small current at a very high potential is furnished by a Wimshurst machine. One terminal of the machine is connected to a discharging point inside the bell-jar, while the other is connected to the metal plate underneath representing the earth. When the current is turned on, the particles of smoke at once form into long streamers which are deposited on the discharging rod and on the sides of the jar, leaving the air perfectly clear.

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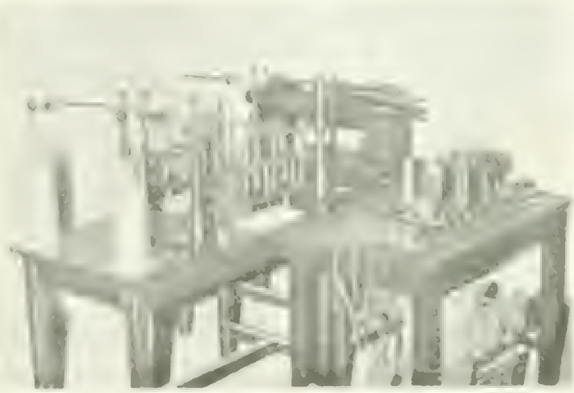

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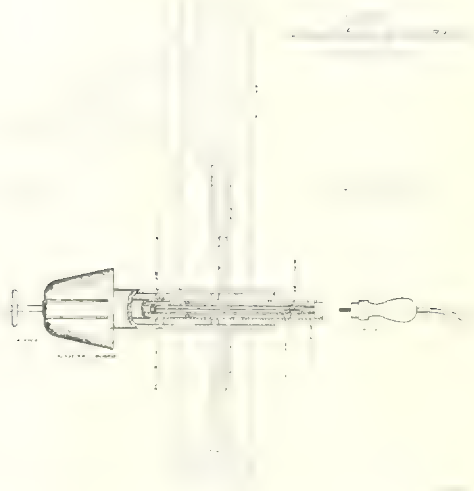

A WALL INSULATOR.

Being the arrangement found necessary for carrying the high-tension leads through a wall, from the high tension rooms to the open air.

This method of dispersing fogs, though easily performed in the laboratory, has not come into practical use on a large scale, owing to the difficulties which arose in the production of a direct current of sufficiently high potential to spit off readily from the discharging points into the atmosphere. The writer shows that until recently it has been impossible to use a dynamo for this purpose owing to there being no continuous current dynamo capable of working at the high potential necessary. Now, however, Mr. Cooper Hewitt's mercury vapour rectifier has been found capable of working at very high potentials, and its use enables alternating dynamos and transformers to be employed; their current being rectified so as to maintain a continuous discharge in one direction. The current supplied by the dynamo is first transformed up to the potential required, then passed through a series of rectifiers, whence the positive and negative wires are taken to the discharging points. It is important that the electrical discharge should take place in the freest possible manner; otherwise an unnecessary strain is thrown on to the rectifiers and insulation. The discharging wires may be arranged with one pole earthed and the other erected on a mast or building, with suitable means for discharging electricity, such as a flame, or a number of points; or in some cases two aerial wires might be used—one for the positive discharging stream and the other for the negative, with a number of points on each. This method of using two aerial wires would be the most suitable arrangement for depositing fume in the flues or settling chambers of factories and for clearing fogs within a limited area. It would be applicable to navigable rivers, subjected to natural fogs. On each bank barbed wires might be suspended parallel to the river and at a safe height from the ground; then positive electricity could be discharged from one side and negative electricity from the other. It is essential that the insulation throughout should be as thorough as possible. Further developments in this field will be watched with the greatest interest.

The agitation to remove the Royal Agricultural Show from Park Royal, and revert to the old custom of holding the show in a different town each year, has not succeeded. At the adjourned meeting of the Society held a few days ago, Lord Middleton announced that Park Royal would again be the venue. The date fixed is June 27th and following days, and it is satisfactory to note that of the £10,000 guarantee required, the greater part has already been subscribed. It appears that the Great Western Railway offered to guarantee the balance of the £10,000 required on condition that the Company received shares in respect of any payments it was called upon to make under such guarantee, but the offer was declined. Statistics show that over a period of forty-one years the Society lost on its annual show a sum of £54,590, and over sixty-five years an average of £829 per annum. The decision to hold another show at Park Royal was not unanimous, and expressions of regret at the abandonment of the country meetings were heard.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

Clun House, Surrey Street, Strand, London, W.C.
[illegible]
[illegible]

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NEWS ITEMS.

[illegible] returns showing incidentally the steady growth of Chinese employment: June, 1904, 1,004; July, 1,388; August, 4,945; September, 9,020; October, 12,005. In the latter month, 14,525 whites and 78,401 coloured employees were engaged in the gold-[illegible]

It is stated that a delay of serious importance has occurred in the completion of the Great Northern and Strand and Piccadilly and Brompton connection of the tube railways of the metropolis, owing to a disagreement between the promoters and the London County Council.

At the meeting of the Institute of Marine Engineers on Monday evening, the President, the Hon C. A. [illegible] R. Balfour, for his paper on "Refrigerating Appliances on Board Ship." The President said that the subject of Mr. Balfour's paper was an interesting and important one, and he himself had devoted not a little attention to the problem.

The Stirling Boiler Company, Ltd., and the Stirling Company, of U.S.A., have come to an arrangement, whereby litigation which had been pending between the two companies for nearly a year has been satisfactorily settled. We understand that the Stirling Boiler Company, Ltd., have acquired all the British and European patents of the American company, and in future all boilers sold in these markets will be of British manufacture. Both the American 4-drum type and the British 5-drum Stirling boiler will be sold in this country. The Stirling Boiler Company, Ltd., [illegible]

Royal College of Science and Royal School of Mines.

[illegible] pointed the Right Hon. R. B. Haldane, K.C., M.P., to be chairman of the departmental committee which [illegible] Mowatt, G.C.B., late Secretary to the Treasury, who, [illegible] having supervened on his illness which were not previously anticipated.

The Training of Apprentices.

Some time ago we chronicled the introduction of a new scheme by Messrs. Richardsons, Westgarth and Co., Ltd., at their Hartlepool works, whereby each apprentice on reaching a certain standard for time-keeping, perseverance, ability, and good conduct in the shops, and for passing examinations at the evening classes, obtained an increase in his weekly pay for the whole year.

We are pleased to hear that the scheme shows continued success. Last year the increase in the boys attaining the minimum standard was for time-keeping 27 per cent., perseverance and good conduct 31 per cent., and for passing examinations 48 per cent. The improvement is obviously due to the greater interest taken by the boys in their work, as they now realise that progress and promotion depend entirely on their own efforts. The foremen are also brought into closer association with the boys, The advances last year range from sixpence to one shilling and twopence per boy per week, or a total of about £170 for the year. The details of the scheme, it will be remembered, were arranged by Mr. D. B. Morrison.

Sir W. H. Preece on Water-Finding.

Since our last issue, Sir W. H. Preece has entered into the Times discussion on Water-Finding, and it is interesting to note that he negatives the suggestion that dowsing is an effect of electricity. "The proper use of electric currents," he writes, "can show the existence of water and of metallic veins, but the so-called 'divining-rod' has nothing whatever to do with electric or magnetic phenomena as far as I can conceive. I have come to the conclusion that it is mechanical vibration, set up by the friction of moving water, acting upon the sensitive ventral diaphragm of certain exceptionally delicately framed persons. That moving water restrained by gravel, hose, pipes, piers, sluices, walls, etc., sets up vibrations is patent to any one who will stand on the pier of a bridge, or place his finger on a hose or tongue on a pipe through which water is flowing. I have even heard sounds emitted by small iron pipes. Telegraph wires hum through the similar friction of moving air. Sea-sickness is probably an exaggerated effect of the same phenomena, and those who patronise the switchback owe their excitement probably to the same cause. Earthquakes produce the same effect."

THE TURBINE STEAMER LOONGANA.

One of a series of illustrations of Parsons' turbine ships shown by the Hon. Charles A. Parsons at the Institute of Marine Engineers. The *Loongana* is the first ocean-going turbine steamer, and was built by Messrs. Denny and Brothers, of Dumbarton, [illegible] her trial trip.

Labour in December

[illegible] place in the engineering trade. On the other hand [illegible]

[illegible]

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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	54,047	[illegible]	[illegible]	[illegible]

[illegible] 17th, the number of workpeople employed was greater [illegible] Midland Counties) than in the corresponding week of 1903. The greatest proportionate increase was in South Wales and Monmouthshire, where the numbers [illegible] district showing the highest average was South Wales [illegible]

Iron and Steel Trade Outlook

[illegible] of employment in many parts of the country it is to be feared that the after effects of the South African war are still felt in many branches of trade, whilst dearer money has affected the expenditure of our [illegible] which otherwise would be undertaken. During the present war between Russia and Japan several depart- [illegible] There is undoubted improvement in the condition of many of those countries with which we trade. India, China, Australia, New Zealand, South Africa, Argentina and Canada all sending us better accounts, which it is to be hoped, says the annual circular of Messrs. William Fallows and Co., will manifest itself in increased trade during the year; but it may be that our patience may be tried before all the anticipations of the more sanguine among us are fully realised.

Direct Railway Service to West Cornwall.

[illegible] a section of line between Newquay and Perranporth, thus completing the connection between the former watering place and Chacewater, and providing a direct service to Truro and West Cornwall generally.

[illegible] Railways Association paid a visit to the works of the Central London Railway. A special car was provided to convey the party to Shepherd's Bush, where the many interesting features of the power house and car sheds were inspected under the guidance of members of the Central London engineering staff.

Standard Specification for Portland Cement.

[illegible] Portland Cement, which forms the latest publication of [illegible]

[illegible] Mr. C. [illegible] C.M.G., [illegible] the [illegible] Council, [illegible] E. W. [illegible]

Andrew Carnegie Research Scholarship.

The following has been issued by the Iron and Steel Institute: A Research Scholarship or Scholarships, of such value as may appear expedient to the Council of the Iron and Steel Institute from time to time founded by the Mr. Andrew Carnegie (president), who has presented to the Iron and Steel Institute sixty-four $1,000 Pittsburg, Bessemer and Lake Erie Railroad Company 5 per cent. Debenture bonds for the purpose, will be awarded annually, irrespective of sex or nationality, on the recommendation of the Council of the Institute. Candidates, who must be under thirty-five years of age, must apply on a special form before the end of February to the Seccetary of the Institute.

The object of this scheme of Scholarships is not to facilitate ordinary collegiate studies, but to enable students, who have passed through a college curriculum or have been trained in industrial establishments, to conduct researches in the metallurgy of iron and steel and allied subjects, with the view of aiding its advance or its application to industry. There is no restriction as to the place of research which may be selected, whether university, technical school, or works, provided it be properly equipped for the prosecution of metallurgical investigations.

The appointment to a scholarship shall be for one year, but the Council may at their discretion renew the Scholarship for a further period instead of proceeding to a new election. The results of the research shall be communicated to the Iron and Steel Institute in the form of a Paper to be submitted to the Annual general meeting of members, and if the Council consider the Paper to be of sufficient merit, the Andrew Carnegie Gold Medal shall be awarded to its author. Should the paper in any year not be of sufficient merit, the Medal will not be awarded in that year.

CORRESPONDENCE.

Delhi-Bombay Motor Reliability Trial.

Hogarth Lane,
Chiswick, London, W.

To the Editor of PAGE'S WEEKLY.

SIR,—We understand that tyre troubles were the principal cause of failure in the Delhi-Bombay Reliability Trial; at least, our representative has cabled us that the Thornycroft car lost no marks except for tyre troubles, but that these latter caused it to be unplaced in the List of Awards.

Faithfully yours,
JOHN I. THORNYCROFT AND CO.,
LTD.

Long Distance Power Transmissions.

Beesfield,
Farningham, Kent.

To the Editior of PAGE'S WEEKLY.

DEAR SIR,—In connection with some extracts which you published from my paper, read before the Liverpool Engineering Society, entitled "Long Distance Transmission of Power from High Head Falls," Mr. Norman Carmichael, of The Highland (Kootenay B. C.) Mining Company, Ltd., has sent me the attached interesting letter.

Yours sincerely,
E. KILBURN SCOTT.

DEAR SIR,—I beg to acknowledge your kindness and courtesy in sending me a copy of your valuable paper on "Long Distance Transmission of Power," which I have read with much interest.

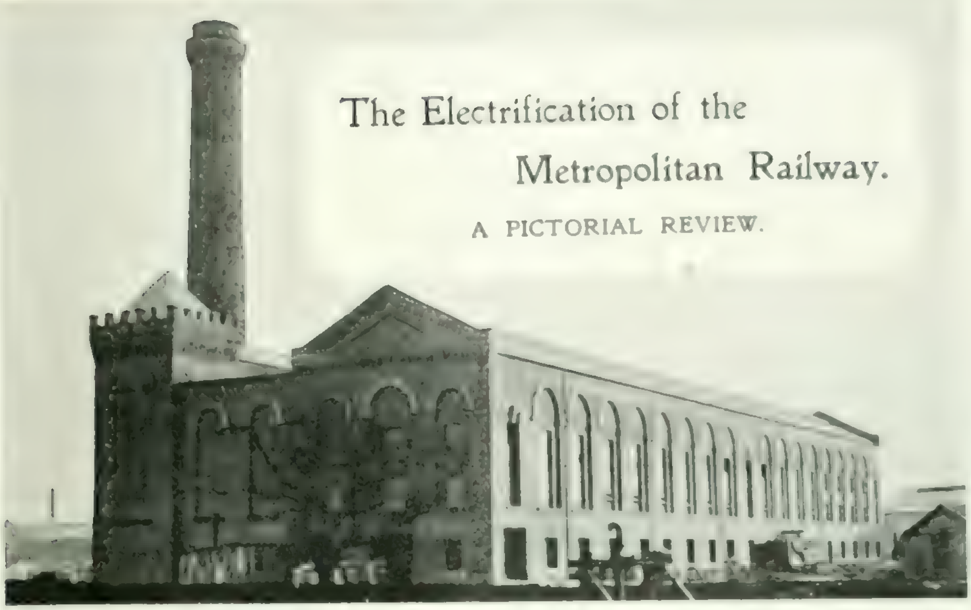
I was much struck with reading the review of your paper in PAGE'S MAGAZINE, with the very practical manner in which you had treated the subject, and it was for purposes of study that I desired the full text. My interest lies more particularly in the primary part of power transmission; the conveyance and application of the water to the wheel as we have to do with it in nearly all our mining operations in this part of the world.

It is not usual here to bury the pipe line, on account of cost, and the rocky nature of the mountain sides usually renders it difficult. At a stamp mill near Nelson, of which I had charge, we had a pipe line 2,000 ft. long, bringing water to the wheels under a 680 ft. head, the diameter of the pipe being 12 in., 10 in., and 8 in., the upper 500 ft. being slip joint, and the lower 1,500 ft. being flange joints.

During the winter of 1902–3, we had a severe spell of weather for a fortnight the mercury hovering around zero, and we noticed the power getting shorter as the cold snap continued. By tapping the line it was easy to discover that ice was forming round the inside of the pipe, but no serious trouble was anticipated, and the water was kept running through the pipe. Then came a sudden thaw with heavy warm rain, and this loosened the ice round the inside of the pipe; the ice eventually breaking away and choking the pipe at the point where it was reduced from 12 in. to 10 in., and completely stopped the water.

This happened at a point about 200 ft. from the penstock, or about 500 ft. vertically above the nozzle, and at about midnight I was on my way up to the penstock to find out what was the matter when the jam broke, and ice, water and all came tearing down the pipes with an almost deafening roar. Fortunately the valve at the wheel was open, and some of the pressure was relieved no damage was done there; but on reaching the point where the jam had taken place, I found that about 60 ft. of the pipe had collapsed with the vacuum. The relief valves had failed to act, as it was impossible to keep them from freezing up, this was the only occasion in four years experience that their services were required. A few clamps and two lead joints made the pipe right, and there has never been any trouble with it since.

Yours faithfully,
NORMAN CARMICHAEL.



The Electrification of the Metropolitan Railway.

A PICTORIAL REVIEW.

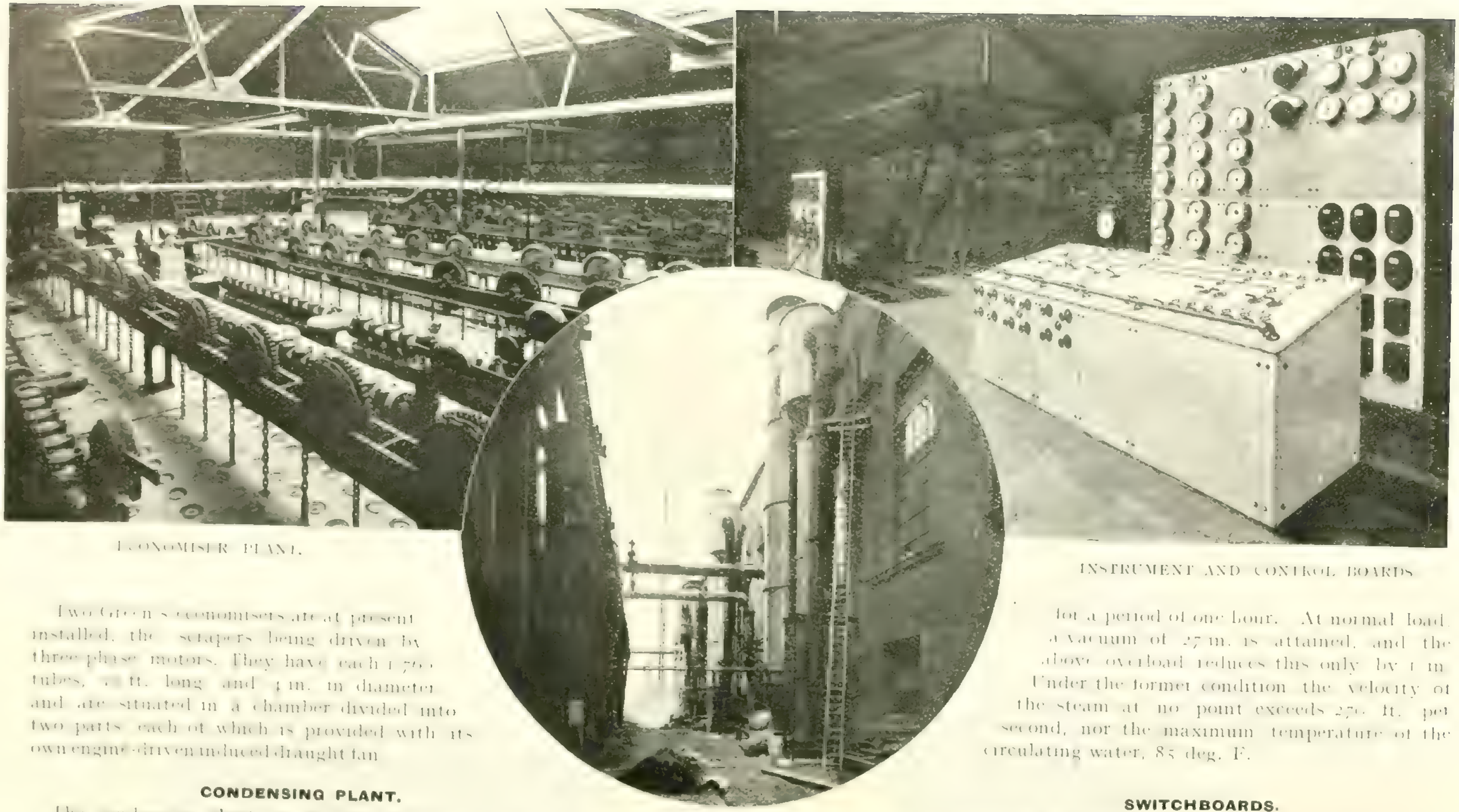
THE NEASDEN GENERATING STATION.

The Metropolitan Railway Company's generating station is situated close to their locomotive and engineering works at Neasden. An abundant supply of water for boiler [illegible] wells have been sunk to tap it. The main building of the power station is 327 ft. long by [illegible] the world owned by a single railway company.

By the courtesy of the British Westinghouse Company we are enabled to present our readers with a pictorial survey of some of the leading features of interest in connection [illegible]

BOILER ROOM.

[illegible] room, measuring 321 ft. long by 53 ft. wide. It [illegible] mechanical stokers, which latter are driven through gearing by Westinghouse vertical enclosed [illegible]



ECONOMISER PLANT.

CONDENSERS.

INSTRUMENT AND CONTROL BOARDS.

Two Green's economisers are at present installed, the scrapers being driven by three-phase motors. They have each 1,760 tubes, 10 ft. long and 4 in. in diameter and are situated in a chamber divided into two parts each of which is provided with its own engine-driven induced draught fan.

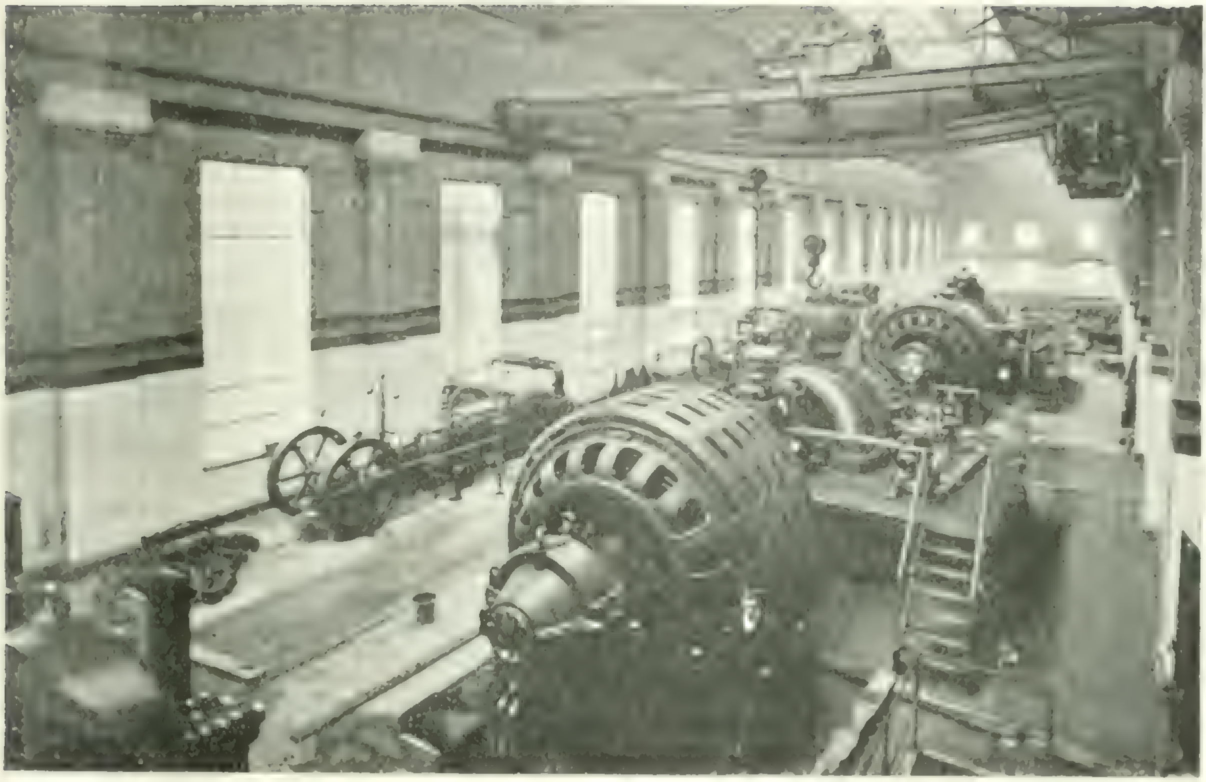
CONDENSING PLANT.

The condensing plant is of the barometric type and was made by the British Westinghouse Company at their Trafford Park Works to the designs of the Alberger Condenser Company.

This is a form of condenser that is little known in England, but it was chosen because it is particularly adapted for maintaining the high vacuum at all loads that is such an important feature in the economical working of the steam turbine. Condensers are installed for each main generating unit, and they are separately capable of dealing with 60,500 lb. of steam per hour at normal full load, and 110,000 lb. per hour at maximum overload for a period of one hour. At normal load a vacuum of 27 in. is attained, and the above overload reduces this only by 1 in. Under the former condition the velocity of the steam at no point exceeds 270 ft. per second, nor the maximum temperature of the circulating water, 85 deg. F.

SWITCHBOARDS.

There are two sets of main 'bus bars, to either of which the generators may be connected by the aid of two switches in series, the one next to the machine a simple main circuit oil-break switch, and the other between this and the 'bus bars, the selector switch for connecting the generator to either set of 'bus bars. In addition, isolating switches are provided and placed electrically, right on the 'bus bars to allow for safe inspection or repair of the controlling apparatus. By closing both of the selector-switches it is possible to operate with both sets of 'bus bars in parallel.

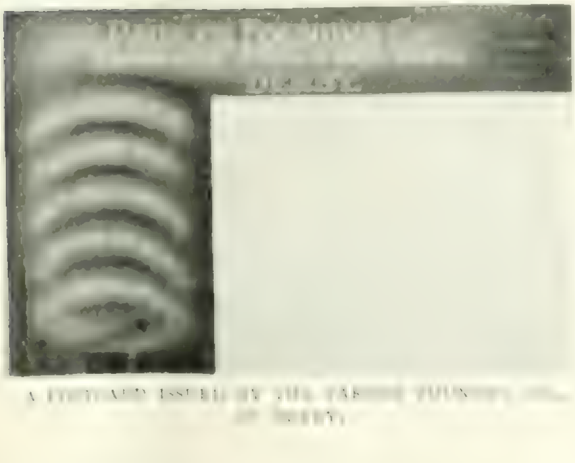


[illegible]

[illegible] 180 lb per square inch. These machines represent the latest practice in every detail, particularly in the reduction [illegible]

The three-phase generators are mounted on a continuation of the turbine bed plate. The output per phase on [illegible] field of [illegible] to the [illegible]

(To be continued.)



A POSTCARD ISSUED BY THE PARKER FOUNDRY CO., OF DERBY.

A BUSINESS POSTCARD.

[illegible] colours.

QUESTIONS OF THE DAY.

The National Encouragement of the British Inventor: How can it be secured? *(Continued from page 76.)*

THIS discussion, which opened in PAGE'S WEEKLY for October 28th, 1904, has called forth some very valuable expressions of opinion by practical men which can scarcely fail to carry considerable weight when the patent question is again before Parliament. In the meantime Mr. Thwaite has prepared a very interesting summary of the views expressed, and as the initiator of the discussion, he has also favoured us with the following general reply to close the correspondence. Says Mr. Thwaite:—

Mr. Balfour, in a reply given last week to a communication from the "London Chamber of Commerce," as to the desirability of reforming some of the clauses of the new Patent Act, does not admit that evidence has been supplied to him, so far to justify any change in the Act.

It is quite certain that Mr. Balfour has not read the opinions expressed in these columns from representative inventors and men associated with them directly and indirectly.

The opinions expressed on some of the objects are so emphatic and unanimous and the arguments urged in support of drastic reform are so irresistible that no member of His Majesty's Government or its Opposition, unless he is conspicuously indifferent to the welfare of his country, can ignore them. I sincerely trust that your enterprise in devoting so much of your valued space to collecting and publishing the various opinions, will culminate in a really practical issue, and will tend in the direction of making the British patent laws the most fostering, and the least costly of any extant.

I will, in brief terms, first refer to the replies of the inventors themselves to the interrogatories you have set out partly under my guidance.

A SUMMARY OF THE VIEWS OF REPRESENTATIVE INVENTORS.

1. The fifty years' period constituting the time range of the search is generally considered to be satisfactory by inventors.*

2. All renewal fees after the fourth year to be abolished. Scale of charges not to exceed those of the American Patent Bureau.

The British Patent Department not to be run at a profit, any surplus over expenditure to be employed:—

(1*st*) To increase the efficiency of the department; and

(2*nd*) To the reduction of patent charges.

3. British patents to be classified and analysed, the work to be supervised by technical experts representing each of the staple industries.

4. The unanimous opinion of British inventors is in favour of the extension of the life of a British patent from 14 to 17 years.

5. Strong personal evidence proves that the effect of the renewal fees is to strangle invention.

6. The general opinion appears to consider the British patent department as unfitted for the work of deciding (first) the value of an invention that has been commercially perfected, and (second) whether the time and money expended has been justified by the results.

The general opinion is also decidedly in favour of the extension of the life of a patent to 17 years, the commercial perfection of which has been costly, both in time and money, but it is considered that the extension of the patent might be limited to 21 years.

---

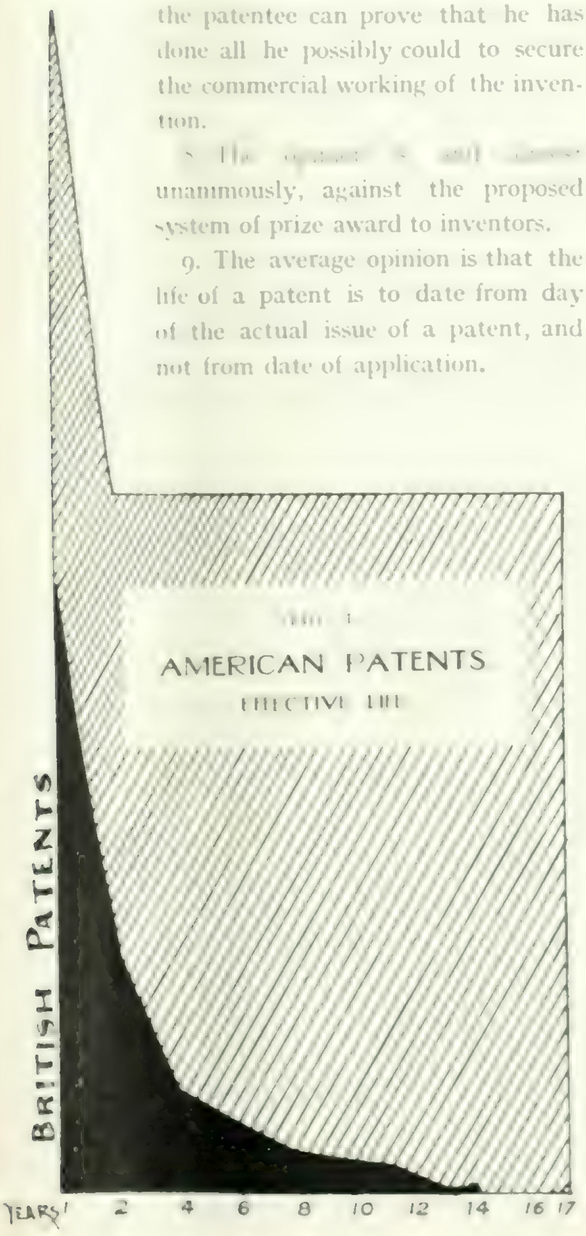
* [illegible] a [illegible] in the Patent Court [illegible] B. H. T.

7. On the question of working or non-working, opinion is in favour of the compulsory license clause of the Act.

In the event of a patent being contested the fact that a patent is not being worked should have weight in the adjudication, that is, unless the patentee can prove that he has done all he possibly could to secure the commercial working of the invention.

8. The opinion is, and almost unanimously, against the proposed system of prize award to inventors.

9. The average opinion is that the life of a patent is to date from day of the actual issue of a patent, and not from date of application.



10. When a foreign country insists on working proof, the inventors of that country shall be compelled to work their British patents in precisely similar terms to those meted out to the British inventor.*

11. On the question of the fixing the royalty rates, opinion is divided; the Patent Department is considered to be unfitted to determine Royalty rates.

12. The adjudication on patent disputes: opinion almost unanimously in favour of the appointment of a tribunal of technical experts assisted by a legal associate.

THE VIEW OF CONSULTING ENGINEERS

[illegible] with that of the inventors themselves, and especially so on the questions of the duration of the British Patent, [illegible] reciprocal terms with foreign countries as to com- [illegible]

Life of patents involving large expenditure of money and time in commercial perfection to be extended in proportion to such expenditure.†

THE INIQUITOUS RENEWAL FEE TAXATION.

[illegible] or reducing the detestable principle of taxation (embodied in the existing renewal fees) after the fourth year has not, amongst the non-inventor participators in the discussion, received the consideration its importance deserves.

[illegible] conspicuously the deadly effect of the Renewal Fees [illegible] all deference to those who have extended their dis- [illegible] destroyed by the effect of the renewal fees, that they [illegible] with the struggles of the great body of British inventors.

[illegible]

[illegible]

† [illegible]

bulk of British patents, and if anyone wished to demonstrate the falling back on the rate of progress of this country in the last ten years (and proportionate to its population) he has merely to refer to the existence of the policy of *laissez faire* and indifference, that has permitted a crushing taxation on British invention to exist for so many years to the great and immeasurable loss of the country.

Puerile in the extreme are the arguments that have been suggested in favour of retaining this repressing influence on inventors. It is suggested that the lapsed patent will permit other inventors to follow in the path of this invention, but no one supporting this argument has brought forward any evidence to prove that an invention based on a patent abandoned by the *force majeur* influences of inadequate finance is likely to prove of value to the inventor, because its basis is admittedly a defunct but published patent.

The one practical suggestion as an alternative to the suppression of the tax is that made by Mr. Thompson the patent expert.

Mr. Thompson suggests that an annual renewal fee of 10s. would amply meet all the requirements and remove all the objections advanced against the repeal of this iniquitous principle of taxation. Probably most inventors would welcome the reduction of the present charges to the nominal value suggested by Mr. Thompson.

SHOULD THE GOVERNMENT MAKE THE PATENT OFFICE A PROFIT-EARNING DEPARTMENT?

The argument raised by one correspondent that there will be no profit surplus to admit of the suppression, or at least the reduction of the renewal fees, is met by the fact that the American patent department secures a substantial but not unreasonable surplus—although this department institutes a search and there are no renewal fees after the patent has been granted. It is admitted that the American patent classification is the finest in existence, so that if the American Government can run its Patent Bureau without incurring a financial loss, and provide a search and grant of a patent life of 17 years for [illegible] *paribus*, our Government should be able to do so.

It is almost the unanimous opinion of all the correspondents that the principle of making a profit out of the Patent Office administration for the benefit of the National Exchequer is iniquitous, and damaging to the best interests of the country.

It is quite conceivable that the effect of this correspondence will be to secure for the German inventor happily circumstanced as he is, a reduction of patent taxation to the level of that of the American patent system. Anyone personally intimate with the two countries, realises the extent of the interchange of ideas of our two formidable rivals, and, if this correspondence in any way tends to the reduction of the German patent fees, it will have justified its existence by benefiting a race of inventors, that can claim *inter alia*, the Siemens family, Dr. Otto, The Krupps, Liebig, Nernst, Welsbach, Hertz Rontgen, and a host of others whose work has benefited the human race directly or indirectly. There should be no dividing geographical or racial division amongst votaries of the creative art. The inventor is *amicus humani generis*. Even our Hiram Maxim's inventive creations will tend to check a too ready recourse to war as the means for settling international disputes. Creative work, whether it produces new mechanical applications or chemical or electrical processes, or works of the beaux arts, is the product of the same kind of genus. Let anyone compare the portraits of Listz, the composer, and George Corliss, the inventor; or those of the late Lord Leighton and Sir John Thorneycroft, and he will notice a striking resemblance between them. Our Government permits creative faculty applied to the production of art or literature to secure proprietary rights for the creative output for the period of a lifetime by a simple form of registration and the payment of 10s., but the man who creates a new machine, or a process that in its effect produces two blades of grass where one grew before, is penalised, and increasingly, by the annual taxation known as the renewal fees.

Compare, moreover, the expenditure involved in perfecting a machine or process with that required in producing a design or painting.

No! The iniquitous taxation of the inventor has no *raison d'etre*, and has already done immense damage to the industrial and commercial well-being of the country.*

(*To be continued.*)

[illegible] secure—either for himself or his friends—the return of the expenditure [illegible]

[illegible] resulted in the adoption of the principle of disastrous taxation, em- [illegible] and more alive to the value of the creative products of their inventive countrymen.

[illegible] acquire the knowledge that experience should provide, but any practical experience can [illegible] Patent Office are men who have held positions of responsibility in manufacturing works, or [illegible] are fully competent to judge the pros and cons of an innovation which may appear to be a mere detail, but which is nevertheless the missing link of a change of important processes.

THE EFFECT OF THE ABANDONED PATENTS (PRINCIPALLY THROUGH THE MALIGN INFLUENCE OF THE RENEWAL FEE TAXATION) ON FUTURE INVENTIVE EFFORT.

[illegible] that of resuscitation.

Had these mostly-renewal tax killed patents had the life given to a patent by the American Government—or seventeen years—scores of combinations of different inventors would have been made, because in nine cases out of ten, an inventor would adopt the policy of combination rather than that of the dog in the manger, which in its effect is often equivalent [illegible] one's face.

THE PROPOSED COURT OF TECHNICAL EXPERTS.

[illegible] definite is in favour of the German model.

There should be no difficulty in establishing courts of technical experts in the great branches of British Institutions, even if you have to import German or American experts.

The somewhat vulgar phrase of the *vox populi* that the British law is an ass, is accepted too seriously not to have some justifiable basis for its existence, and just as technical and business questions of immense importance are daily settled without recourse to legal assistance, so can disputes relating to inventions be settled by the Courts of Experts, which may have the assistance of legal assessors.

THE QUESTION OF THE LIFE PERIOD TO BE ALLOWED FOR A PATENT.

[illegible] Mr. Heath in his highly philosophic contribution to support his bold contention, that the life of an important patent should be perpetual, are academically [illegible] employed to the detriment of inventors. No! An inventor should have time allowance to realise the value of his inventions—and in this connection I appreciate the suggestion advanced by Mr. Swinburne that small inventions, or inventions relating to articles that can be made suitable for the market in a few months, on the expenditure of a few pounds, should be satisfied with a smaller patent life monopoly, than the inventor who patents an invention, the commercial perfection of which requires years of time and thousands of pounds.

THE COMPETENCY OF THE NEW CORPS OF EXAMINERS.

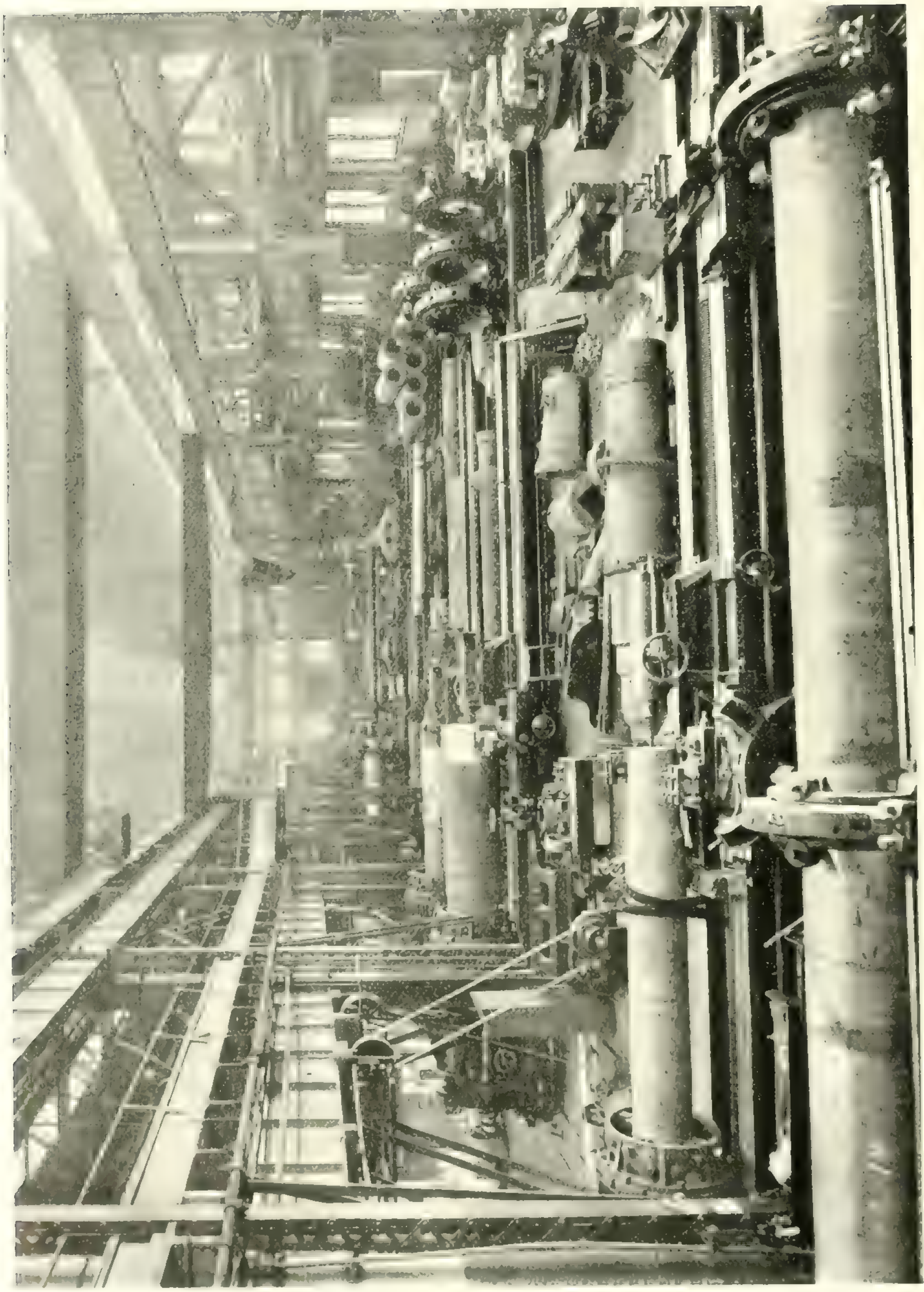
There has never been any desire to reflect on the competency of the Patent Office staff to carry out the provisions of the old Act. The only question raised is the competency of the Searching and Examining Corps appointed to differentiate between new and old inventions.

Anyone who is fully cognisant of the complexity of most of our modern manufacturing industrial processes, and who adequately appreciates how often the success of a new process is secured by an apparently trivial, but what is, in reality, an all important detail and one constituting the pith and marrow of an invention, will be justified in his distrust of the opinion, upon the subtle value of a detail, of a member of a staff that is innocent as a newborn babe of a practical knowledge of the manufacturing process to which the invention belongs.

CLEVELAND INSTITUTION OF ENGINEERS.

At the meeting of this Institution, held on the 10th inst., Mr. J. H. Harrison, M.Inst.C.E., read an interesting [illegible] the Manufacture of Iron and Steel."

The conclusion at which the author arrives is that while a good deal is being done to meet foreign competition, there is still ample room for reform in English methods of manufacture and management. He does not advocate the slavish imitation of American methods, holding that there is a middle course between American practice and our own, which, if properly [illegible] plant and then in arranging that plant so as to make the process of manufacture continuous from the [illegible] to the finished product, with the least [illegible]



ORDNANCE MACHINE SHOP—THE MIDVALE STEEL COMPANY.

A GROUP OF FORGED STEEL SHOT AND SHELL, ARMOUR PIERCING AND COMMON, [illegible] 13 IN., 6 LB. TO 1,100 LB., BY THE MIDVALE STEEL COMPANY.

STEEL FOR THE MANUFACTURE OF ARTILLERY.

By Colonel Cubillo (Spanish Royal Artillery).

III.

(Continued from page [illegible].)

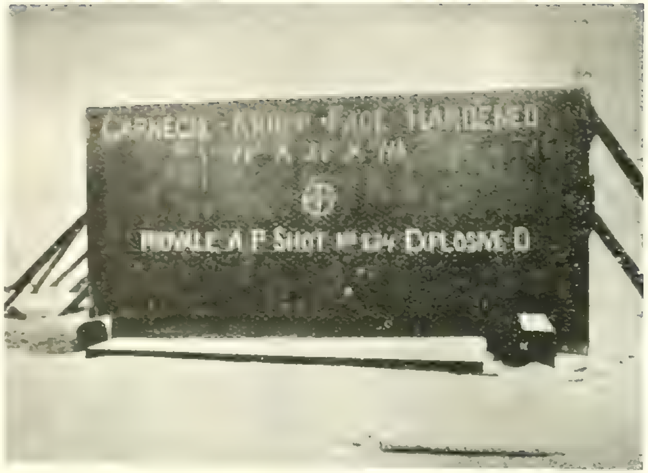
We will now turn to an important experiment with cannon metal effected in the Watertown Park. The Watervliet Works had observed that, as much in solid forged tubes as in hollow forged sleeves, there existed certain shades or stains of a dark colour, narrow in proportion to their length, and running in a line with the axis of the piece. These stains were discovered when smoothing the tubes and sleeves in the lathe, according to the class of tool used in this operation they appeared more or less in relief. A file darkened them; a half cut of the tool made them jut out; if a large shaving was made they were hidden. These are observations of American officials; we have had more than one occasion to notice these stains at Trubia; no gun of 15 centimetres is stained in this manner.

It is not easy to point to the cause of these shades; perhaps we may attribute them to the cavities or bubbles formed at the moment of the solidification of the steel. This, however, is a mere hypothesis, the true cause is unknown. The traction characteristics of a metal free from stains, and those of having them in abundance are as follows, and not unfavourable to the latter metal :—

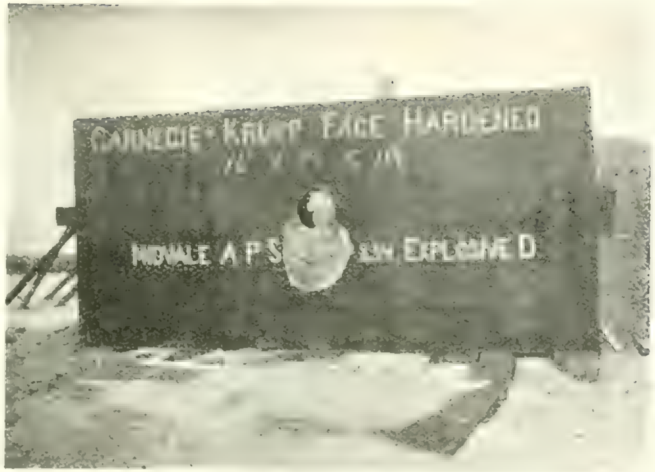
	[illegible] Limit. Kg/mm²	[illegible] Kg/mm²	[illegible]	[illegible]
Metal with Stains:				
Average [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Maximum …	[illegible]	[illegible]	[illegible]	[illegible]
Minimum	[illegible]	[illegible]	[illegible]	[illegible]
Metal without Stains:				
Average	[illegible]	[illegible]	[illegible]	[illegible]
Maximum	[illegible]	[illegible]	[illegible]	[illegible]
Minimum	[illegible]	[illegible]	[illegible]	[illegible]

As seen from this table we cannot say that one metal is inferior to the other: that free from stains or lines possesses greater tenacity, whereas the other has greater ductility; perhaps we [illegible] [illegible] that the metal free from stains is the inferior.

The chief of the Artillery Technical Department ordered the Watertown Arsenal to

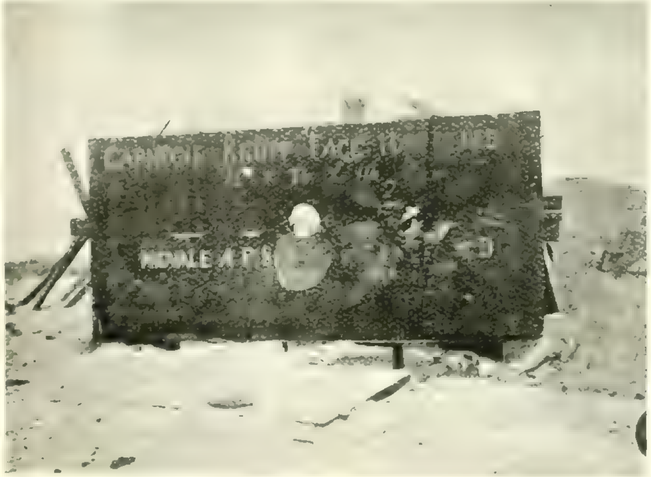

CARNEGIE-KRUPP FACE HARDENED
MIDVALE A.P. SHOT No 134 EXPLOSIVE D

12-IN. ARMY SERVICE RIFLE TARGET—BEFORE FIRING.



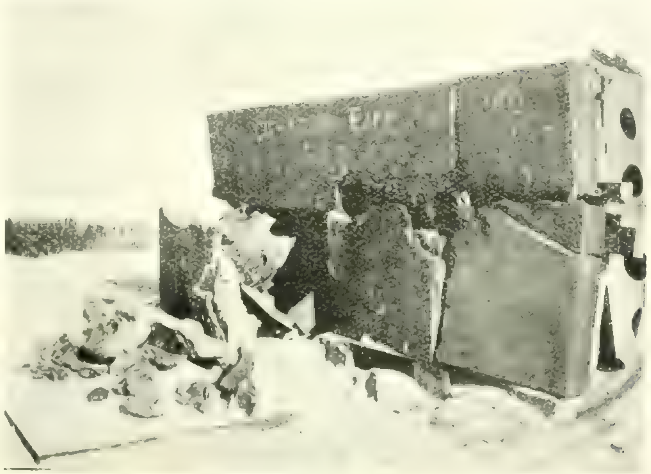
12-IN. ARMY SERVICE RIFLE TARGET—FIRST ROUND.

Midvale Armour-Piercing Shot, 1,001 lb. 7 oz., 1,800 ft. per second velocity, 4,400 yds. range, 22,500 ft. tons striking energy.



12-IN. ARMY SERVICE RIFLE TARGET—SECOND ROUND.

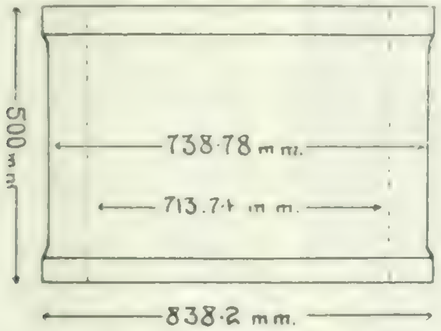
Midvale Armour-Piercing Shot, 1,006 lb., 1,804 ft. per second velocity, 4,400 yds. range, 22,500 ft. tons striking energy.



12-IN. ARMY SERVICE RIFLE TARGET—THIRD ROUND.

Midvale Armour-Piercing Shot, 1,045 lb., 2,073 ft. per second velocity, 1,880 yds. range, 31,100 ft. tons striking energy.

experiment with both classes of metal, submitting a hoop of each to hydrostatic pressures which should not exceed the tangential elastic resistance of the steel, repeating the operation a certain number of times, and afterwards increasing the pressure until the hoops fractured. The dimensions of the hoops are shown below:—



It is not necessary to say what means were adopted to exert the pressure required. After noting the tangential elastic resistance of the hoops, their dimensions and traction characteristics, they were submitted to pressures of 150 to 200 kilogrammes per square centimetre less than those employed for elasticity. This pressure was repeated 500 times on each hoop and was then increased until they fractured. Neither hoop showed any appreciable permanent deformation from the 500 pressures, but after passing the elastic limit the difference between the two metals was very marked. In the shaded metal three small stains or lines opened perceptibly under a pressure of 4,100 kilogrammes, and at 4,600 kilogrammes one of the three openings increased in size. The metal of the other hoop bore the strain up to the fracturing limit admirably. The stained metal hoop broke under a pressure of 6,350 kilogrammes per square centimetre. The elastic limit of the two coincides with the minimum value found in the traction tests. In breaking, the stained metal gave less resistance than that shown in the test and was very deficient in elongation, the hydrostatic test giving only 4 per cent., whereas 18 per cent. was shown by the traction test. On the contrary, the clear metal showed greater resistance and elongation. The results of these experiments are very interesting; they indicate, first, that the traction tests alone are not sufficient to give an idea of the quality of a metal, and that defects of much importance on passing the elastic limit do not exist between that period of the resistance not passed by the fire tests. It is clear that the officials who conducted these experiments did not apply a slowly increasing pressure until fracture occurred, but repeated the elastic pressure 500 times, because, without doubt, this would be the number of rounds fired from a big-calibre gun, and if any guns in use had been constructed of sleeves and hoops of stained metal, they would have been convinced that these guns were in no danger of bursting.

In the writer's opinion, the tests within the elastic limit, such as made by the American Commission, may be likened to the shooting tests, because, if in these tests the pressure reaches its maximum in a very short time, it is also certain that it quickly disappears. In the hydrostatics proof, the increase of the pressure is slow; but the time occupied is always much longer than that taken by the rounds in the bore of the gun.

THE FUTURE OF THE PEDRAIL

A practical demonstration of the capabilities of Mr. Diplock's patent Pedrail was recently made before the Admiralty and at the [illegible], Liverpool. The demonstration was of an interesting nature and was followed with great interest. Mr. Diplock mentioned that the present Pedrail had an average speed of [illegible] miles per hour, but that he was at present designing one to average eight. He saw [illegible]

OUR WEEKLY BIOGRAPHY.

Professor ALFRED KIRBY HUNTINGTON, A.R.S.M., F.I.C., M.I.M.M.

PROFESSOR A. K. HUNTINGTON, Chief of the Metallurgical Department, King's College, was born in Norfolk in 1856. His father was the third son of John Barker Huntington, of Somerton Hall, his mother a daughter of Henry d'Esterre Hemsworth, D.L., of Shropham Hall.

He went through what he considers the usual indifferent secondary education of English schools, and then stayed with relations in France for about two years, attending College and receiving private tuition. Returning to England he worked for a short period in the Secretary's Office of the General Post Office at about the time when the Government assumed control of the

[illegible]

[illegible] of the country. [illegible] to [illegible] career, he joined the Royal School of Mines in 1874, [illegible] in 1877 with the Associateship [illegible] Mining and Metallurgy.

He next collaborated with Dr. Guthrie in his well-known work on Cryohydrates which led up to the far-reaching discovery of "eutectics" in metallic alloys, and the recent greater progress in Metallography; was associated with Professor W. N. Hartley in his fruitful researches on "Absorption Spectra of Ultra-Violet Rays," and with Dr. Percy in laboratory investigations for the second volume of his Metallurgy of Gold and Silver, which, however, was never published, the work eventually being incorporated in the German edition of the first volume. In 1879 Professor Huntington was elected to fill the Chair of Metallurgy at King's College, London, since when he has been continuously occupied in investigations having practical applications in Marine and Railway Engineering. He was one of the first to experiment with an electric furnace, the late Sir William Siemens having placed at his disposal the electric furnace shown at the Smoke Abatement Exhibition. It was afterwards transferred to Professor Huntington's laboratory, where it was worked by five D2 dynamos, driven by a 12 h.p. Marshall's portable engine. The light given by the arc was computed at the time at 200,000 candle power.

In 1882, conjointly with Sir William Siemens, Professor Huntington, read before the Southampton Meeting of the British Association a paper on some of the results of the experiments in the electric furnace. This was the first occasion on which tungsten had been shown in any other condition than that of powder. With its high fusing point and a volatilisation point near that at which the metal [illegible] a powder being a [illegible] of heat, it is extremely difficult to obtain tunsgten in a solid condition. Whilst experimenting with this furnace, iron and carbon were fused in time and the production of carbide and from [illegible] were found, but no attempt was made to develop this fact commercially.

About this time, Professor Huntington gave a course of six lectures in Birmingham to those interested in the brass industries. These were attended by from 800 to 1,000 students each night. A year later he was requested to give a course on iron and steel, but being of opinion that this was not the most advantageous way to deal with education, he induced those concerned to equip a laboratory at the Midland Institute, which proved to be the precursor of many laboratories in different parts of the country. In 1892 he was instrumental with others in forming the Institution of Mining and Metallurgy, and in 1894 was elected President. Professor Huntington's contributions to the technical press include a text-book on "Metals," and a number of papers to be found in the transactions of various scientific societies. He is an enthusiastic aeronaut and motorist, and in the last-named connection he is experimenting with an automatic change-speed gear which shows fair promise of practical [illegible]

THE LODGE FOG DISPERSAL APPARATUS.

[illegible] of the L[illegible]

STANDARD SPECIFICATION FOR PORTLAND CEMENT.

THE specification just issued by the Engineering Standards Committee on Portland Cement, provides that the cement shall be prepared by intimately mixing together calcareous and argillaceous materials, burning them at a clinkering temperature and grinding the resulting clinker. No addition of any material is to be made after burning, except when desired by the manufacturer and if not prohibited in writing by the consumer, in which case calcium sulphate or water may be used. The cement, if watered, must contain not more than 2 per cent. of water, whether that water has been added or has been naturally absorbed from the air. If calcium sulphate is used, not more than 2 per cent., calculated as anhydrous calcium sulphate, of the weight of the cement is to be added.

The cement is to be ground to comply with the following degrees of fineness, viz.:

The residue on a sieve 76 by 76 = 5,776 meshes per square inch, shall not exceed 3 per cent.

The residue on a sieve 180 by 180 = 32,400 meshes per square inch shall not exceed 22½ per cent.

The sieves are to be prepared from standard wire, and the size of the wire for the 5,776 mesh shall be ·0044 inch, and for the 32,400 mesh, ·002 inch. The wire must be woven (not twilled), the cloth being carefully mounted on the frames without distortion.

DIMENSIONS OF BRIQUETTE

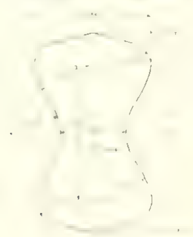


Fig A

DETAILS OF JAWS FOR HOLDING BRIQUETTE

PLAN

Fig B.

ELEVATION

The specific gravity of the cement is to be not less than 3·15, when sampled and hermetically sealed at the manufacturer's works, nor less than 3·10 if sampled after delivery to the consumer.

The cement must comply with the following condition as to its chemical composition. There shall be no excess of lime, that is to say, the proportion of lime shall not be greater than is necessary to saturate the silica and alumina present.* The percentage of insoluble residue shall not exceed 1·5 per cent.; that of magnesia shall not exceed 3 per cent.; and that of sulphuric anhydride shall not exceed 2·5 per cent.

The cement after being gauged, is to be filled, without mechanical ramming, into moulds of the form shown in fig. A. plate I, each mould resting upon an iron plate until the cement has set.

Briquettes of neat cement of the shape shown in fig. A, are to be gauged for breaking at 7 and 28 days respectively, six briquettes for each period. The average tensile strength of the six briquettes shall be taken as the accepted tensile strength for each period. For breaking the briquette must be held in strong metal jaws, of the shape shown in fig. B., the briquettes being slightly greased where gripped by the jaws. The load must then be steadily and uniformly applied, starting from zero, increasing at the rate of 100 lb. in 12 seconds. The briquettes are to bear on the average not less than the following tensile stresses before breaking:—

7 days from gauging, 400 lb. per square inch of section. 28 days from gauging, 500 lb. per square inch of section. The increase from 7 to 28 days shall not be less than:—

25%, when the 7 day test falls between 400 lb. to 450 lb. per square inch of section; 20% when the 7 day test falls between 450 lb. to 500 lb. per square inch of section; 15% when the 7 day test falls between 500 lb. to 550 lb. per square inch of section; 10%, when the 7 day test is 550 lb. per square inch or upwards.

Details follow as to the prescribed sand test, setting time, soundness, and acceptance, for which we must refer readers to the original specification.†

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* [illegible] and alumina [illegible] CaO [illegible] SiO [illegible]

† Published by Crosby Lockwood and Son [illegible] from the [illegible] Committee at 28, Victoria Street, Westminster, S.W.

IMPROVED MOTOR-DRIVEN HEXAGON TURRET LATHE.

BY MESSRS: ALFRED HERBERT, LTD., COVENTRY.

THE illustration on page 134 shows the latest development of the Patent Hexagon Turret Lathe built by Messrs. Alfred Herbert, Ltd., Coventry. The machine as shown is driven by a direct-connected electric motor which has a moderate range of speed variation, a large proportion of the speed changes being obtained mechanically by means of friction clutches in the lathe headstock.

It is found that the use of motors having a large speed variation causes trouble owing to the reduced power of the motor at low speeds, and it is for this reason that a motor having a comparatively small speed variation, obtained by inserting resistance into the field circuit, is used. By this arrangement the motor gives its maximum power at the slow end of the speed range, the lighter efforts being reserved for the small diameters and the smaller cuts. The motor is of the direct-current type driving the headstock by means of spur-gearing, and is compactly arranged. The switches and controller are mounted on a stand seen at the left-hand side of the machine, this being a convenient position for the operator. This type of machine has been designed principally for producing articles such as screws, studs, spindles, etc., direct from the bar without forging. In cases where forgings must be employed, as in connecting rods with forked ends, these can be easily handled by removing the automatic chuck and substituting a three or four-jaw chuck. Owing to the form of the turret, which is hollow, allowing the work to pass right through it, both long and short work is handled, and, as the patent turning-attachments are very readily adjusted for diameter, it has been found quite economical to produce even one or two pieces at a setting, the lathe being extensively used in jobbing and repair work.

The leading principle of the machine is that it finishes each diameter from the rough bar at one cut, no finishing cut being required, and the design has just been modified so as to take full advantage of the recent improvements in high-speed cutting tools.

The bar is gripped by an automatic chuck, operated by the vertical lever at the front of the headstock. The chuck may be opened and closed without stopping the machine. The end of the bar is steadied by means of a 3-jaw self-centring chuck, which is operated by the handwheel at the rear end of the spindle. The automatic chuck is provided with a full set of jaws for gripping round, square or hexagon bars up to the full spindle capacity, the jaws not in use being carried in a swinging tray conveniently attached to the cabinet leg. This tray also carries the screwing dies and cutting tools.

The hexagon turret is mounted on a saddle having a long bearing on the bed. The saddle is provided with an automatic feed having three changes, all obtainable by moving the vertical lever seen on the front of the gear box. The feed may be reversed by throwing over the small horizontal lever immediately above the feed change lever. The feed is [illegible] [illegible] [illegible] the machine. The automatic stops for the travel of the turret are carried on the hexagon bar in the front of the machine. These [illegible]

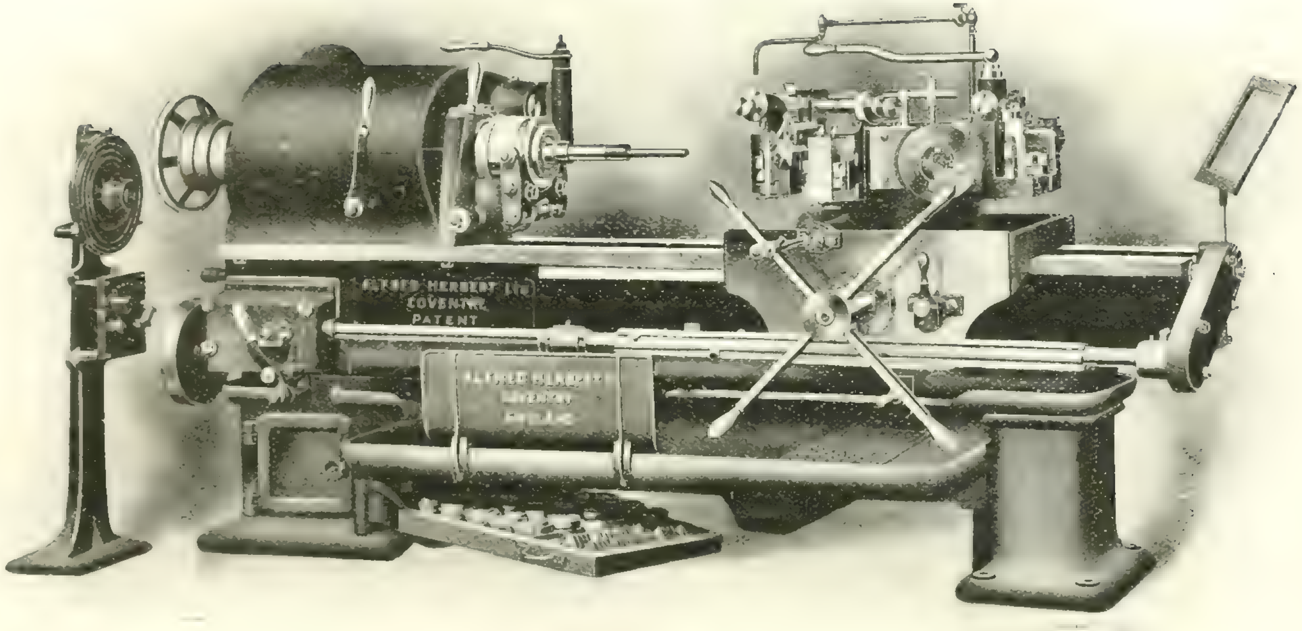
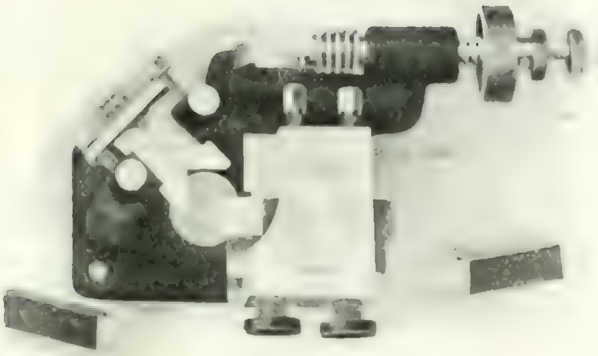


FIG. 1. IMPROVED MOTOR-DRIVEN HEXAGON TURRET-LATHE BY MESSRS. ALFRED HERBERT, LTD., COVENTRY.

face of the turret. The hexagon bar revolves in unison with the turret, thus bringing that stop into action which relates to the particular tool which is working; consequently any tool can be adjusted to turn any given length without interfering with the others. The feed is tripped by means of a dropping worm.

The turning toolholders are one of the most important features of his machine. They are capable of dealing with any required reduction in diameter at one cut, and are so arranged that the same toolholder can be used for cutting either towards or away from chuck, the change being made by simply substituting a left hand cutter, using the same toolholder and steadies. On long work it is necessary in order to produce a true running job to commence close up to the chuck and to feed away from the head-stock, thus keeping the job in tension. The illustration (fig. 2) shows the turning tool-holder very clearly. After the tool has been clamped down all adjustments of tools



[illegible]

and [illegible] are made entirely with the [illegible] and without the need of screw-drivers or spanners Screwing is done by means of the "Coventry" self-opening diehead, which is arranged to open automatically at any desired point, and is also fitted with a roughing and finishing attachment by which means a finishing cut may be taken when screwing large threads on difficult material.

Although these machines have been largely used for ordinary bar work, such as shafts, bolts, pins, studs, bushes, etc., there are yet a number of jobs which might appear to be unsuited for the lathe, but on which we are assured that great economies can be effected. Work such as piston rods, air-pump rods, armature spindles, which have a long plain portion in the centre, are frequently made on these machines from bright drawn steel bars which are not machined at all on the plain central portion, but are subsequently finished on this part by grinding if a fine finish is required. One end is first machined, the work is then reversed, the part machined at the first operation being supported in a bush fitted in the spindle so as to hold it true, and the second end is then finished. Work of this kind can also be centred in the lathe for the subsequent operation of grinding

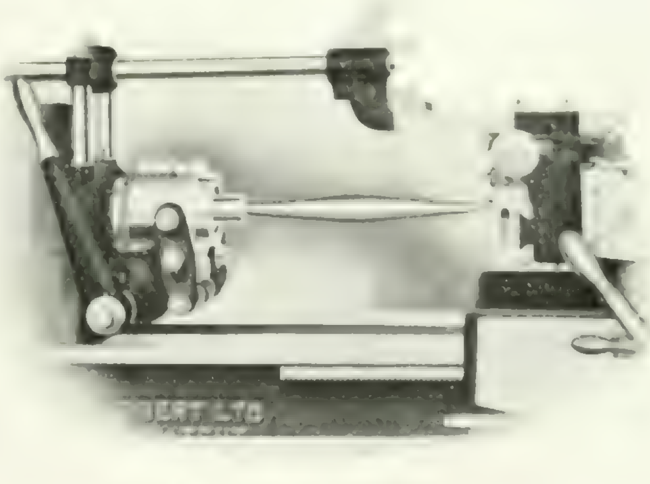
Work, such as boiler stays, having two threaded portions separated by an unthreaded portion can be produced by a special arrangement of diehead and guide nut so that the pitch of the two threaded portions may be continuous so as to suit the error of the stay tap. For repetition work having a number of diameters, box tools are furnished enabling all the diameters to be turned at the same time.

For taper work a special taper-turning tool is fitted with an adjustable taper bar, which can be set to any desired angle. For work having curved outlines, broad form tools are used; examples of such work will be found in the pilot handles on lathe itself.

No. [illegible] machine admits bars up to [illegible] in. diameter, working stroke of turret 30 in., maximum size of Whitworth thread cut with self-opening diehead 1¼ in., or 2 in. with special diehead.

No. 3 machine admits bars up to 2½ in. diameter, working stroke of turret 36 in., maximum diameter of Whitworth thread cut with self-opening diehead 2 in.

No. 5 machine admits bars up to 4½ in. diameter, working stroke of turret 42 in., maximum size of Whitworth thread cut with self-opening diehead 3 in. [illegible] in. with special diehead.



[illegible] SPECIAL [illegible]

The Heat Treatment of High-Speed Steel.

By J. M. Gledhill.

THE high-speed steels of the present day are combinations of iron and carbon with (1) tungsten and chromium, (2) molybdenum and chromium, and (3) tungsten, molybdenum and chromium. In the heat treatment of high-speed steel, one of the most important points is the process of thoroughly annealing it after working into bars. Accurate annealing is of much value in bringing the steel into a state of molecular uniformity, thereby removing internal strains that may have arisen, due to casting and tilting, and at the same time annealing renders the steel sufficiently soft to enable it to be machined into any desired form for turning tools, milling cutters, drills, taps, screwing etc., etc.

The annealing of high-speed steel is best carried out in muffle furnaces (see fig. 2), designed for heating by radiation only, a temperature of 1,400 deg. F., being maintained from twelve to eighteen hours according to the section of the bars of steel dealt with.

Further advantage also results from careful annealing by minimising risks of cracking when the steel has to be reheated for hardening. In cases of intricately-shaped milling tools having sharp square bottom recesses, fine edges, or delicate projections, and on which unequal expansion and contraction are liable to operate suddenly, annealing has a very beneficial effect towards reducing cracking to a minimum.

Increased ductility is also imported by annealing, and this is especially requisite in tools that have to encounter sudden shocks due to intermittent cutting, such as planing and slotting tools, or others suddenly meeting projections or irregularities on the work operated on.

It may be noted that the ductility of annealed specimens is very good, rendering the steel in a condition to withstand the great pressures due to the [illegible] upon it when cutting.

PREPARATION OF HIGH-SPEED STEEL.

In preparing high-speed steel ready for use the process may be divided principally into three stages: forging, hardening, and grinding. It is, of course, very desirable that high-speed steel should be capable of attaining its maximum efficiency and yet only require treatment of the simplest kind, so that an ordinarily skilled workman may easily deal with it, otherwise th[illegible] costly matter, and materially reduces the advantages resulting from its use. Fortunately, the treatment of the rapid steel produced by the author's firm is of the simplest; simpler in fact than ordinary carbon steels or the old self-hardening steels, as great care had to be exercised in the heating of the latter steels, for if either were heated above a blood-red heat, say 1,600 deg. F. the danger of impairing their efficiency by burning was considerable; whereas with the high-speed steel, heating may be carried to a much higher temperature, even up to melting point, it being practically impossible to injure it by burning.

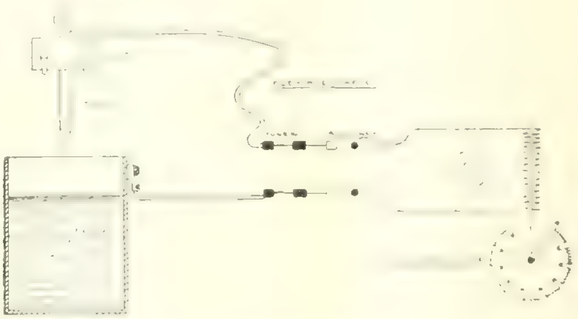


FIG. 1. APPARATUS FOR ELECTRICALLY HEATING THE POINTS OF TOOLS.

The steel may be raised to a yellow heat for forging, say 1,850 deg. F., at which temperature it is soft and easily worked into any desired form, the forging proceeding until the temperature lowers to a good red heat, say 1,500 deg. F., when work on it should cease and the steel be reheated.

In heating a bar of high-speed steel preparatory to forging (which heating is best done in a clear coke fire) it is essential that the bar be heated thoroughly and uniformly, so as to ensure that the heat has penetrated to the centre of the bar, for if the bar be not uniformly heated, leaving the centre comparatively cold and stiff, whilst the outside is hot, the steel will not draw or spread out equally, and cracking will probably result. A wise rule in heating is to "hasten slowly."

It is not advisable to break pieces from the bar whilst cold, the effect of so doing tending to induce fine end cracks to develop which ultimately may extend

[illegible]

TEMPERATURE FOR HARDENING

The temperature for hardening high-speed steel [illegible] dealt with.

When hardening turning, planing or slotting tools, and others of similar class, the point or nose of tool only should be gradually raised to a white melting heat, though not necessarily melted, but even should the point of the tool become to a more or less extent fused or melted no harm is done. The tool should then be immediately placed in an air blast and cooled down, after which it only requires grinding and is [illegible]

[illegible] the tools is as follows :—

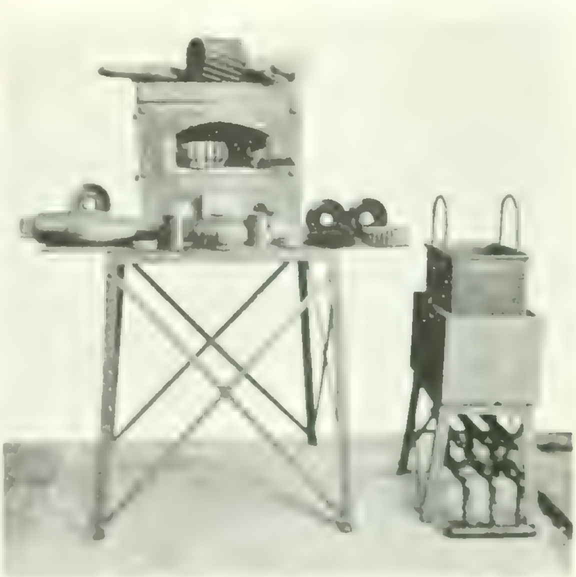
Forge the tools as before, and when quite cold [illegible] operation which may be done with the tool fixed in a rest and fed against the stone or emery wheel by a screw, no harm resulting from any heat developed at this stage. The tool then requires heating to a white heat, but just short of melting, and afterwards completely cooling in the air blast. This method of first roughly grinding to shape also lends itself to cooling the tools in oil, which is specially efficient where the retention of a sharp edge is a desideratum, as in finishing tools, capstan, and automatic lathe tools, brass-workers' tools, etc.

In hardening where oil cooling is used the tools [illegible] melting, and then cooled down either by air blast or in the open to a bright red heat, say 1,700 deg. F., when they should be instantly plunged into a bath [illegible]

Referring to the question of grinding tools, nothing has yet been found so good for high-speed steels as the wet sandstone, and the tools ground thereon by hand pressure, but where it is desired to use emery [illegible] shape on a dry emery wheel or dry stone before hardening. By so doing the tools require but little grinding after hardening, and only slight frictional heating occurs, but not sufficient to draw the temper in any way, and thus their cutting efficiency is not impaired. When the tools are ground on a wet emery wheel and undue pressure is applied, the heat generated by the great friction between the tool and [illegible] tends to produce cracking.

With regard to the hardening and tempering of specially formed tools of high-speed steel, such as milling and gear cutters, twist drills, taps, screwing dies, reamers, and other tools that do not permit of being ground to shape after hardening, and where any melting or fusing of the cutting edges must be [illegible]

A specially arranged muffle furnace (fig. 2) heated by gas or oil is employed, and consists of two chambers lined with fire-clay, the gas and air entering through a series of burners at the back of the furnace, and so under control that a temperature up to 2,200 deg. F. may be steadily maintained in the lower chamber, [illegible] temperature.



[illegible]

[illegible]

HARDENING PROCESS DESCRIBED.

The cutters are first placed upon the top of the furnace until they are warmed through, after which [illegible] of about 1,500 deg. F., or, say, a medium red heat, when they are transferred into the lower chamber, and allowed to remain therein until the cutter attains the same heat as the furnace itself, viz., about 2,200 deg. F., and the cutting edges become a bright yellow heat, having an appearance of a glazed or greasy surface. The cutter should then be withdrawn whilst the edges are sharp and uninjured, and revolved before an air blast until the red heat has passed away, and then whilst the cutter is still warm that, is just permitting of its being handled— it should be plunged into a bath of tallow at about 200 deg. F., and the temperature of the tallow bath then raised to about 520 deg. F., on the attainment of which the cutter should be immediately withdrawn and plunged in cold oil.

Of course there are various other ways of tempering, a good method being by means of a specially arranged gas-and-air stove into which the articles to be tempered are placed, and the stove then heated up to a temperature of from 500 deg. F. to 600 deg. F., when the gas is shut off and the furnace with its contents allowed to slowly cool down.

Another method of heating tools is by electrical means, and by which very regular and rapid heating is obtained, and where electric current is available, the system of electric heating is quick, reliable, and economical, and a brief description of this kind of heating may be of interest.

One method adopted of electrically heating the points of tool and the arrangement of apparatus is shown in fig. 1. It consists of a cast-iron tank, of suitable dimensions, containing a strong solution of potassium carbonate together with a dynamo, the positive cable from which is connected to the metal clip holding the tool to be heated, whilst the negative cable is connected direct on the tank. The tool to be hardened is held in a suitable clip to ensure good contact. Proceeding to harden the tool action is as follows:—

The current is first switched on, and then the tool is gently lowered into the solution to such a depth as is required to harden it. The act of dipping the tool into the alkaline solution completes the electric circuit and at once sets up intense heat on the immersed part. When it is seen that the tool is sufficiently heated the current is instantly switched off, and the solution then serves to rapidly chill and harden the point of the tool, so that no air blast is necessary.

Another method of heating the point of tools is by means of the electric arc, the heating effect of which is also very rapid in its action. The general arrangement and form of the apparatus here employed being as illustrated in fig. 3.

The tool under treatment and the positive electrode are placed on a bed of non-conducting and non-combustible material and the arc started gradually at a low voltage and steadily increased as required, by controlling the shunt rheostat, care being taken not to obtain too geat a heat and so fuse the end of the tool. The source of power in this case is a motor generator consisting of a continuous-current shunt-wound motor at 220 volts coupled to a continuous-current shunt-wound dynamo at from 50 to 150 volts. Arcs from 10 to 1,000 amperes are then easily produced and simply and safely controlled by means of the shunt rheostat.

TEMPERING.

Electricity is also a very efficient and accurate means of tempering such forms of tools as milling gear, hobbing and other similar cutters, also large hollow taps, hollow reamers, and all other hollow

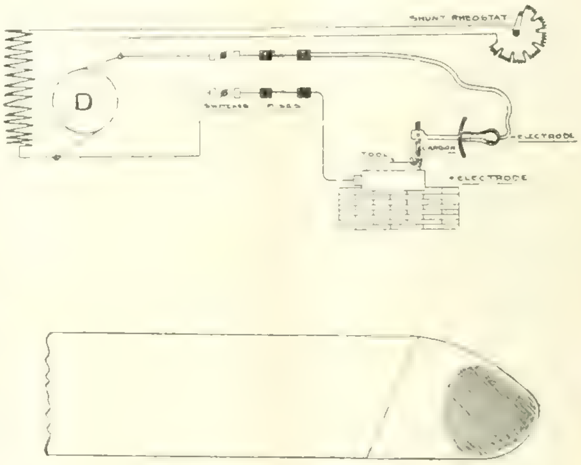


FIG. 3. APPARATUS FOR HARDENING HIGH-SPEED TOOLS BY MEANS OF AN ELECTRIC ARC.

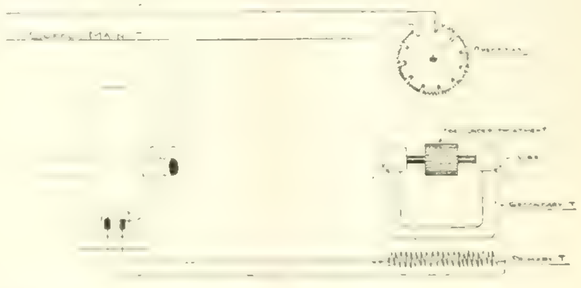


FIG. 4. APPARATUS FOR TEMPERING MILLING CUTTERS, ETC., ELECTRICALLY.

[illegible] by the resistance of the metal being cut, and which stresses tend to cause disruption of the cutter if the hardening extends too deep.

[illegible] this tempering or softening of the interior can be perfectly and quickly effected, thus bringing the cutter into the best possible condition to perform rapid and [illegible]

Tempering of hollow cutters, etc., is sometimes carried out by the insertion of a heated rod within the cutter and so drawing the temper, but this is not entirely satisfactory, or scientific, and is liable to induce cracking by too sudden heat application, and further because of the difficulty of maintaining the necessary heat and temperature required, and afterwards gradually lowering the heat until the proper degree of temper has been obtained. In [illegible] the electric current gradually and steadily heats up the rod until the correct temperature is reached, [illegible] is necessary, and the current can be gradually reduced until the articles operated on are cold again, and consequently the risk of cracking by too sudden expansion and contraction is reduced very greatly. The apparatus used is very simple, as will be seen by reference to the sketch. It consists of a continuous-current shunt-wound motor directly coupled to a single-phase alternating-current dynamo of the revolving field type. The thermal effect of the current is used up in heating the mandril which gradually attains the required temperature, slowly imparting its heat to the tool under treatment until the shade of the oxide on the tool satisfies the operator.

The method adopted to regulate the heat of the mandril is by varying the excitation current of the alternator by means of the rheostat

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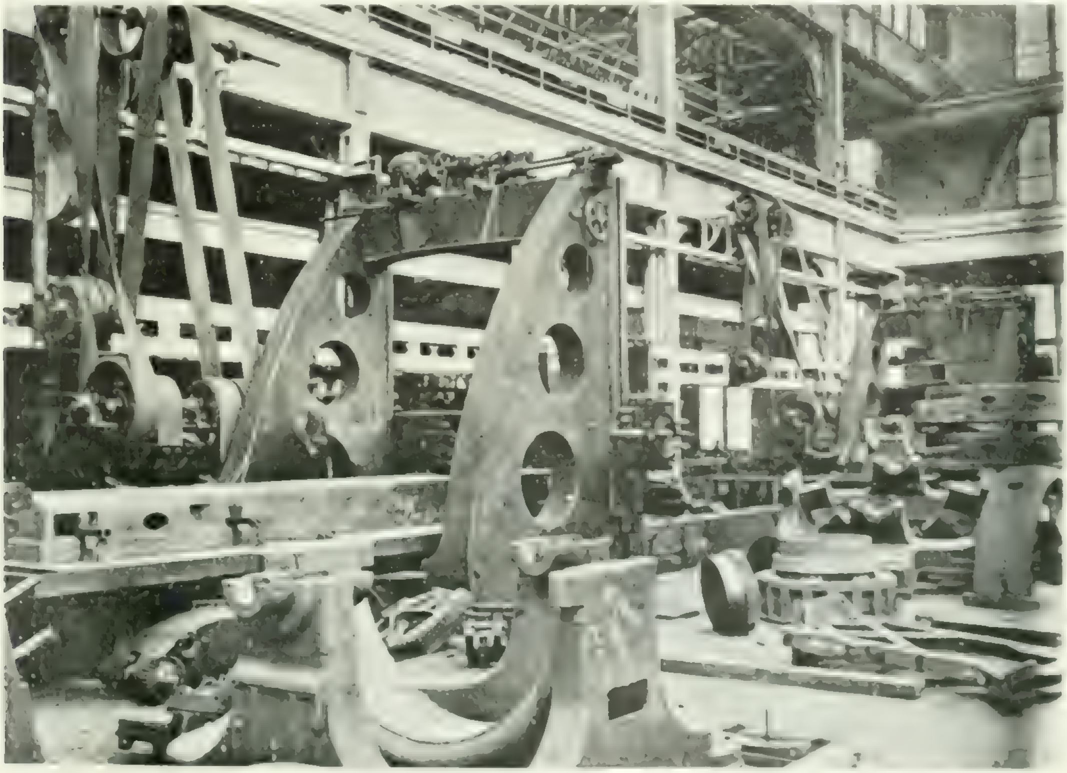
[illegible]



[illegible]
"A.W." HIGH-SPEED STEEL.

[illegible]

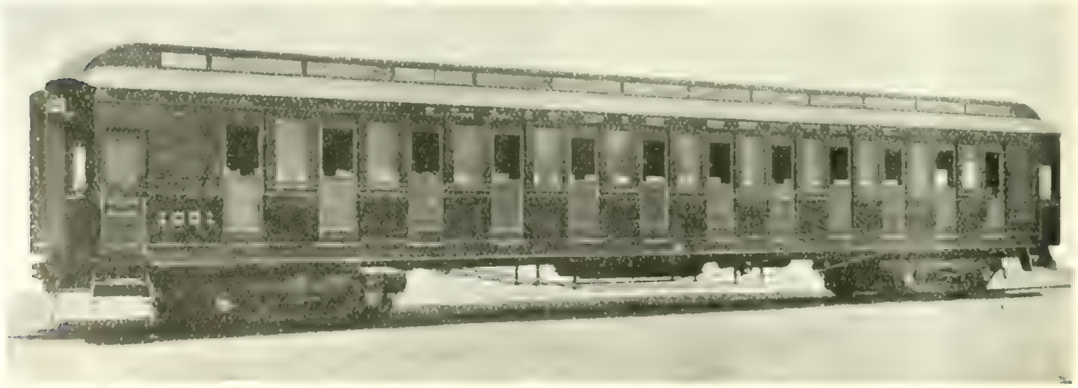
SUBURBAN RAILWAY TRAFFIC.

By A. W. Sullivan.

II.

NO material changes have been made in the type of car used for many years until recently when the Illinois Central Railway built and placed in suburban service at Chicago during the year 1903 several trains consisting of cars of which the entire frame work is constructed of steel. These cars have fixed seats for 100 passengers, arranged in sections transversely of the car, with two aisles, one on each side, between the ends of the seats and the sides of the car, extending the entire length of the car and connecting at the vestibules with end-doors. Opening directly from the aisles are 24 sliding side-doors, 12 on each side. These doors are spaced equal distance apart throughout the length of the car, a door being opposite each section of eight seats. This arrangement of aisles and seats gives great facility to the movement of passengers when entering and leaving the cars, and provides for convenient movement not only throughout the car but throughout the train as well by means of the vestibules and end-doors which connect one car with another. When the side-doors are used, the station platforms are upon the same level as the floor of the car, but at stations where the platforms are low or upon the ground, the doors and steps at the vestibule ends of the cars are used by passengers when entering and leaving, the same as in ordinary end-door cars.

The side-doors slide within the walls, which are hollow, are connected by a mechanism which is operated either by compressed air or by hand in exclusive control of the guard, who rides within the cars, and upon arrival at a station, releases the mechanism so that the doors may be opened separately by the passengers, either from within or outside of the cars. When the passengers have left the cars and those to take the train have entered, the guard by means of the mechanism closes and locks the doors of each car simultaneously; and when all the doors of the train are thus closed and locked, an electric signal is given automatically to the engineman, who then starts the train. So rapid is this method of operation that 100 passengers have been discharged from a car at a terminal station in four seconds, and ordinary stops at intermediate stations where many passengers leave and enter the trains are made in six to eight seconds. The system of automatic electric signals connecting the side-doors with the locomotive admits of long trains being handled with the same facility and dispatch as short trains, and greatly increases all the operating efficiency of the train service.



STEEL-FRAME SIDE-DOOR SUBURBAN CAR ON THE ILLINOIS CENTRAL RAILWAY.
Showing side-doors closed.

[illegible]
[illegible]

TRAIN RUNNING, SPEED, ETC.

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	25 miles	[illegible]
17	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible] miles per hour.

[illegible] and in Brazil 10 miles per hour.

The average time trains are at rest at intermediate [illegible] practice of stopping all trains at all stations within the suburban district, while twenty railways alternate non-stopping trains with stopping trains.

Under the practice of stopping all trains at all [illegible] direction in one hour on a section 26 miles in length with 18 stops; while under the practice of alternating non-stopping trains with stopping trains, the movement of fourteen trains in one direction in one hour [illegible] which stop at all stations. There are no cases reported where precisely similar circumstances exist to enable exact comparisons to be made of the capacity for train movement under the two methods of operation, but it is manifest that the method of alternating stopping and non-stopping trains greatly reduces the capacity of the line for train movement.

The greatest number of trains run into the chief terminal station used by suburban trains in any one [illegible] trains.

The greatest number of trains run into and out of the chief terminal station used by suburban trains in any [illegible] trains.

The number of trains—total of inwards and out- [illegible] average being 193 trains.

Four railways run trains at regular intervals throughout the day without increasing the number during the morning and evening hours. Sixteen railways run trains at regular intervals, supplementing with [illegible] railways run trains at irregular intervals to suit the [illegible]

[illegible] throughout the night.

[illegible]

[illegible]

[illegible]

2. Efficient locomotives.
3. Good organisation.
4. Rigid discipline.
5. Prompt departure of trains from initial station.
6. Short stops and quick work at intermediate stations in discharging and receiving passengers.
7. Distribution of passengers to seats throughout the train after train has resumed motion.
8. Prompt and efficient methods of collecting tickets and fares.

Seventeen railways have no barriers at stations to prevent access to trains; seven railways have barriers which are closed at the time for departure of trains; two railways have barriers which are closed thirty seconds, and two railways one minute before the departure of trains.

NAME OF RAILWAYS.	Number of seats.	Length over end sills of underframe, in feet.	Number of wheels.	WEIGHT.			TOTAL WEIGHT	
				Body.	Trucks	Total	per lineal feet	per seat.
Atlanta & West Point	60	52·5	8	.	..	57,600	1,097	960
Baltimore & Ohio	56	49	8	42,920	16,080	59,000	1,204	1,054
Baltimore & Ohio Southwestern	56	45	8	33,050	15,000	48,050	1,068	858
Boston & Albany	82	61	12	35,230	28,720	63,950	1,048	780
Boston & Maine	65	50	8	32,400	21,700	54,100	1,082	832
	70	55	8	36,350	21,700	58,050	1,055	829
	77	60	8	44,100	23,300	67,400	1,123	875
Central of Georgia	56	50	8	.	.	50,000	1,000	893
	58	53	8	. .	.	53,400	1,008	921
Central of New Jersey	60	51	8	36,900	17,000	53,900	1,057	898
Chicago, Burlington & Quincy	68	51	8	29,400	18,800	48,200	945	709
Chicago & Eastern Illinois	72	56	8	33,100	[illegible]	49,500	884	688
Chicago & Northwestern	60	52	8	41,500	17,000	58,500	1,125	975
Cincinnati, Hamilton & Dayton	64	51·5	8	36,000	17,400	53,400	1,037	834
Cincinnati, New Orleans & Texas Pacific	58	48	8	31,640	15,660	47,300	985	815
	60	52·5	12	33,260	27,040	60,300	1,150	1,005
	64	57	8	46,000	22,000	68,000	1,193	1,062
	68	57·5	8	46,000	22,000	68,000	1,183	1,000
	70	57·5	8	46,300	22,000	68,300	1,188	976
	80	67	12	72,100	37,100	109,200	1,630	1,365
Delaware, Lackawanna & Western	60	51	8	..		60,400	1,184	1,007
	66	52	8	..	.	68,500	1,317	1,038
Erie	58	52	8	.	...	57,150	1,099	985
	62	51	8	.	.	56,950	1,117	919
	66	52	8	..	..	64,200	1,235	973
	72	61	8	...	...	81,650	1,339	1,134
	78	60	8	.	..	69,350	1,156	889
Grand Trunk, Chicago	60	45	8	..	...	47,400	1,053	790
Grand Trunk, Montreal	58	50	8		..	46,350	927	799
Illinois Central, old cars	56	45	8	25,400	16,200	41,600	925	743
Illinois Central, new cars	100	64	8	61,400	23,000	84,600	1,323	846
Minneapolis & St. Louis	56	51	8	37,150	20,350	57,500	1,127	1,027
	60	52	8	39,150	21,350	60,500	1,163	1,008
New York Central & Hudson River	64	54	8	45,100	21,800	66,900	1,239	1,045
	72	60	12	30,800	56,200	87,000	1,450	1,208
New York, New Haven & Hartford	48	40	8	25,300	32,900	58,200	1,455	1,212
	57	45	8	29,300	15,700	45,000	1,000	789
	60	48	8	30,000	17,900	47,900	998	798
	69	60	8	45,000	35,600	80,600	1,343	1,168
Pennsylvania Company	58	46·5	8	29,150	19,000	48,150	1,035	830
	64	54	8	48,700	20,500	69,200	1,281	1,081
Philadelphia & Reading	66	52	8	[illegible]	11,140	63,600	1,223	964
Average	64·61	52·9	8	39,467	[illegible]	[illegible]	1,144	942

TABLE SHOWING DIMENSIONS, WEIGHT, ETC., OF ROLLING STOCK IN USE ON SUBURBAN LINES IN AMERICA AND CANADA.

CONCLUSIONS.

1. [illegible] of passengers for short distances at low rates of fare.

2. [illegible] traffic must be handled rapidly by methods that are [illegible] organisation necessary for the purpose.

3. [illegible]

(*a*) The station accommodation must be convenient and of ample capacity.

(*b*) The arrangements for passengers to go to and from the trains must be short and direct, and the station platforms level with the floors of the cars.

(*c*) Cars must be of large capacity, with side-doors to give the greatest freedom of movement for entrance [illegible]

(*d*) Provision must be made for distribution of passengers throughout the train while in motion.

(*e*) Adequate safeguards must be provided for protection against personal injury, chiefly for the purpose of preventing passengers from entering or leaving the cars while in motion.

(*f*) Trains must be of the greatest capacity consistent with economical movement.

4. The car, as the vehicle of transportation and the primary unit, is the factor to which everything else must conform.

5. In the case of new lines to be constructed, the type of car should first be determined and the railway then designed to fit the car.

6. In the case of old lines, to develop the greatest transportation capacity, the car should be of such size as will utilise in the highest degree the space between tracks upon tangents; the curves should then be [illegible] upon tangents, in order to admit of the use of a car of the maximum size upon all parts of the line.

7. The locomotive should be proportioned to handle [illegible]

8. The track and bridges should have stability and strength requisite to safely and economically carry at speed the locomotives and trains required for [illegible]

9. The greatest train movement and the highest degree of safety and of economy in operation are to be attained by schedules which provide for the movement of trains at uniform speed and stopping at all stations, upon the same tracks.

10. That separate tracks should be provided upon lines of heavy traffic for trains which are run at high speed and do not stop at all stations.

11. [illegible] tion is to conserve the expenditure of energy, and avoid the necessity of regaining time lost, by preventing the loss of time at stations.

12. To this end the prompt movement of passengers should be provided for, and no loss of time should occur in the departure of trains when the purpose for which a stop is made at a station has been accomplished.

13. That the frequency of train movement should be proportioned to the volume of traffic, to avoid congestion at stations.

14. The system which combines the foregoing requisites in the highest degree may be deemed the most perfect.

OBITUARY.

By the death of Mr. James Napier, Glasgow has lost a prominent member of the iron trade.

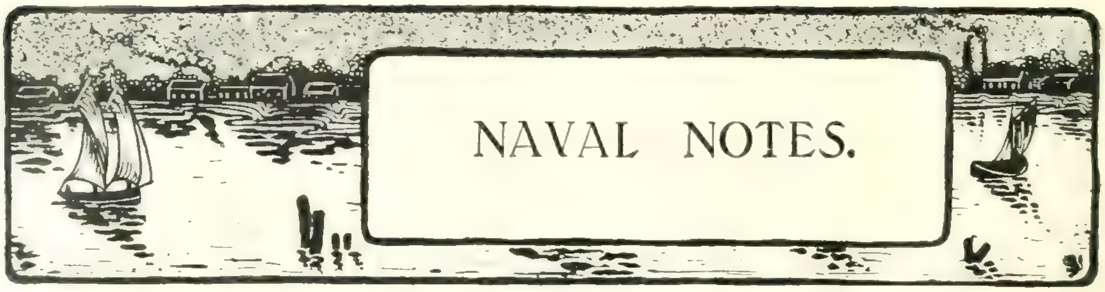
Earl Cairns, who died suddenly at Cannes on Saturday last, was the third son of the great Lord Chancellor. The bent of his mind was towards engineering, and he worked for some years in Sir W. G. Armstrong, Whitworth and Co.'s gun factory. At the time of his death he was a partner in the Elswick Ordnance Company.

The death is reported of Mr. James Kerr, of Aintree. Mr. Kerr was connected with the Lancashire and Yorkshire Railway for a period of over forty years.

Mr. Thomas Fenwick, the well-known Leeds civil engineer, lived to the ripe age of eighty, and his recollection carried him back to the beginnings of railway locomotion, he having been associated in his early years with both George and Robert Stephenson. He was originally a member of the engineering firm of Martin and Fenwick, of Leeds, but in later [illegible] in conjunction with them was closely identified with the development of Leeds.

The news of the death of Mr. James Harvey Williams, [illegible] J. H. Williams and Co., has been received with much [illegible] forgings.

The death is announced of Mr. William Beswick Myers-Beswick, a well-known member of the leading [illegible] years a partner in the firm of John Fraser and Sons, Leeds, and was concerned in the construction of a [illegible]



NAVAL NOTES.

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

DURING the past fortnight we have had much evidence of the great changes which are being brought about by the new scheme of distribution. In all 116 vessels have been put into commission in reserve, comprising nine battleships, twenty cruisers, two torpedo gunboats, forty-two destroyers, and forty-three torpedo boats, and of these six battleships and six cruisers are on the emergency list. The Admiralty return of last March showed that in all there were fifty-seven battleships which counted as effective vessels. Only two of those vessels are included in the ships to be struck off the effective list, and to-day, including all the *King Edwards* which did not figure in that return, there are only sixty-five. There is a saving, however, in the annual upkeep of thirteen old vessels, quite inefficient and not included in the return, which could only be regarded at best as forlorn hopes. Thirteen armoured cruisers, forty protected cruisers, thirty-six gunboats and torpedo gunboats, and twenty-one sloops, hulks, etc., are also transferred to the sale list, and are being removed from the dockyards to the various mooring grounds which have been decided on. Some forty or more are destined for the Motherbank, a large number also will be taken to the Kyles of Bute, and the remainder will be distributed in various locks and creeks around the coast.

Arguments for and against battleships of moderate dimensions continue to be bandied about, but the fact that no fewer than forty vessels of 16,000 tons and over are building for various Powers is sufficient proof that the trend of thought in the Admiralty Departments of the Powers is not towards the small battleship. The fact that Germany does not build such leviathans is easily explained by the necessity for her vessels to be of moderate displacement for use in the comparatively shallow waters of the Baltic and the North Sea. In the meantime we are proceeding with the construction of large vessels, and last week the keel plates of the [illegible] down. The battleship *Hindustan*, of the *King Edward* class, has completed her trials, and the *Hibernia*, which is building at Devonport is ready for launching. She will not, however, be put into the water until July, and she will then be in a very advanced state. The *Sentinel* scout has also completed her trials with very satisfactory results, attaining a speed of 25 knots. The *Sapphire* and *Diamond* third-class cruisers are now almost ready to receive their nucleus crews, and will shortly proceed to join the Reserve divisions at Sheerness, Chatham, and Devonport, respectively.

Launches of three torpedo-boat destroyers have taken place since the beginning of the New Year, the *Ness* on January 5th, and the *Gala* and *Ouse* on January 7th.

The announcement has been made, and there seems to be no reason to doubt its accuracy, that Captain Percy Scott is to be made the head of a new department at the Admiralty, with the title of "Director of Target Practice," or some similar designation. The American navy has long possessed such a department, and there is every reason to believe that it would have been greatly beneficial to the shooting of the British Fleet if this reform had been earlier introduced. Captain Percy Scott is one of the best known men in the Service, and there can be no doubt about the popularity of his appointment to the Directorship of the new department. The gunnery efficiency of our fighting Fleet is not perhaps all that it might be; but, with an officer of Captain Scott's experience at the head of affairs, aided by an adequate staff of gunnery experts, with full powers, the standard of our shooting can conceivably be raised to very great heights. It may be noted in this connection that a new gun, to be known as the 12 pr. (18 cwt.) quick-firer gun has been ordered for issue to the Navy. It is stated to be greatly superior to the present 12 pr. (12 cwt.) gun, and the improvements in the breech lock are stated to enable more rounds to be fired per minute, with greater velocity, accuracy of aim and range.

THE WEEK AMONG THE TECHNICAL SOCIETIES.

INSTITUTION OF ELECTRICAL ENGINEERS.

FUEL ECONOMY IN STEAM-POWER PLANTS.

AN [illegible] George Street, Westminster, on January 12th.

[illegible] and John B. C. Kersham.

The following is an abstract of the paper :—

Economy in most or all electrical-power plants as usually understood is at present unattainable. In [illegible] really durable and efficient storage battery would raise the load factor probably eightfold. In the case of the traction power-house economy in the fullest sense is a question of accumulators.

The authors assume that the fullest economy of first cost, and more especially of running cost, are recognised by all station engineers as only obtainable in the present state of knowledge by means of a battery. But they are also aware that the battery is so far from perfect that its adoption in any case must still be a matter of grave and careful deliberation.

Steam-power economy is to be secured by attention to fuel and its combustion, feed-water and its treatment and heating, furnace design and arrangement, steam treatment and its use in suitable engines.

Most electrical engineers admit the importance of attention to the physical and chemical characteristics of their feed-water supply, and they recognise the impossibility of obtaining the highest efficiency from their boilers, if the water is passed into them without preliminary heating, carrying all the original suspended dirt and dissolved impurities. The authors direct attention to the increased efficiency which is obtained from boilers fed with water at or above 212 deg. F., the real cause of which is not yet determined, although a [illegible] mechanical work, the heat energy of the fuel being devoted in the boiler to the conversion of the water into steam.

FUEL SUPPLY

The importance of the fact that fuel represents 50 per cent. of the total works cost in the generation [illegible] when contemplating the low price at which they have placed their fuel contracts. [illegible] is worth effecting, even when these costs are exceptionally low ; and systematic sampling and testing of the fuel would in many cases be found to save money. The testing of fuel for technical purposes should cover moisture, ash, coke, volatile matter and calorific value ; the last being calculated from the approximate analysis and also ascertained by burning from ½ to [illegible] fuel calorimeters.

The authors assert that with suitable furnace construction and scientific control, bituminous fuels can be burnt without causing smoke troubles and with high efficiency under every type of boiler, and that great savings in fuel costs could be effected in this direction. But the furnace construction must be adap[illegible] fuel, and it is absurd to suppose that furnac[illegible] for burning anthracite or semi-anthracite fuel, will satisfactorily burn fuels containing 30 per cent. or more of volatile matter. The percentage of volatile matter which a fuel gives off when heated is, in fact, a measure [illegible] combustion, and it is here that the laboratory examination of fuel yields results of the greatest value. That such an examination is still regarded as unnecessary and of no help in the placing of fuel contracts is clear proof of how much has still to be learned in the scientific control of steam plant

[illegible] past to the question of adapting the furnace construction and methods of firing to the fuel, and whatever boiler-makers chose to recommend has been much too readily accepted. Most of the electricity works [illegible] Wales coal [illegible]

CAUSES OF LOW INITIAL FURNACE TEMPERATURE

[illegible] and remedy for the former

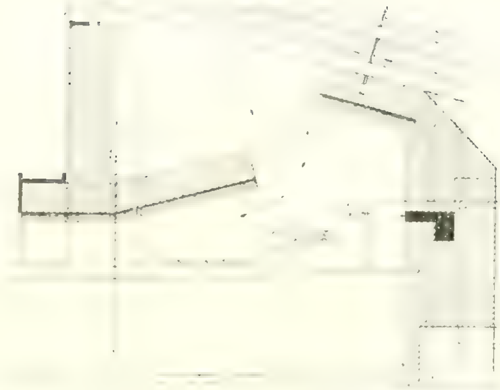


FIG. 2. REFRACTORY FURNACE OF BABCOCK BOILER (KENSINGTON AND NOTTING HILL).
Form—Correct. Environment—Good.

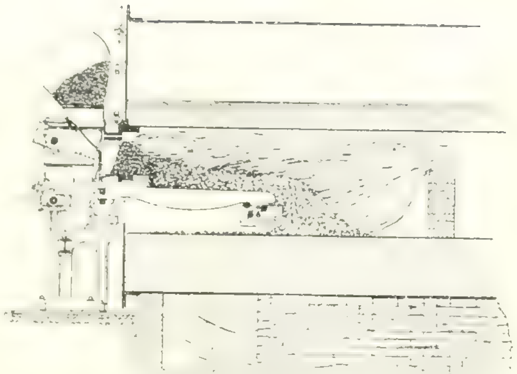


FIG. 4. VICARS STOKER, WITH SHORT GRATE AND GAS PRODUCER PIT.

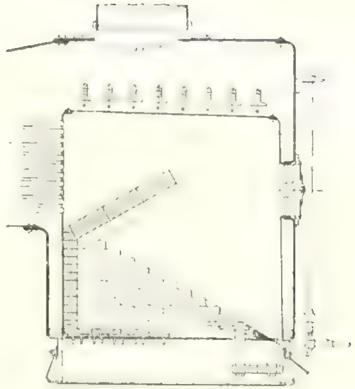


FIG. 6. LOCOMOTIVE BOILER, BRICK-LINED FOR LIQUID FUEL.

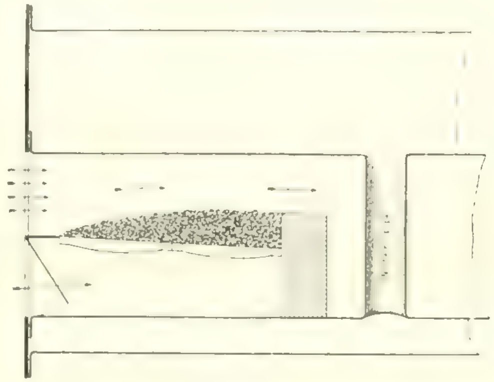


FIG. 3. ORDINARY FURNACE OF LANCASHIRE BOILER.
Form—Correct. Environment—Bad.

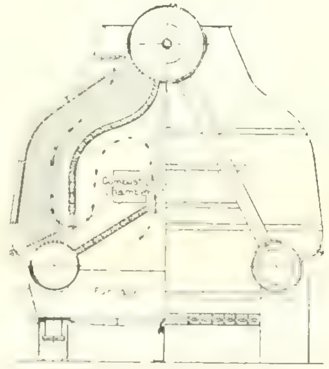


FIG 5. WEIR WATER-TUBE BOILER, WITH REFRACTORY FURNACE AND COMBUSTION CHAMBER.

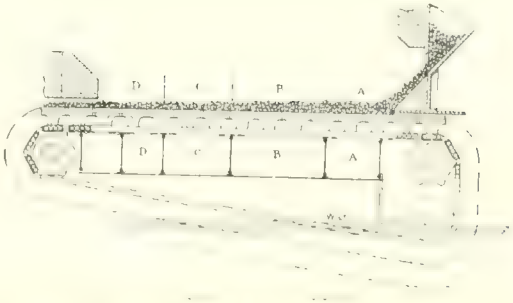


FIG. 7. CHAIN GRATE STOKER, WITH AIR-REGULATING CHAMBERS BELOW.

[illegible] to these two points alone, but even then the limit of [illegible] By the use of a heated air supply in conjunction with closed-in ash-pit and induced or forced draught, much higher temperatures can be attained in the boiler furnace; and should Rowan's suggestion for working such furnaces under two or three atmospheres pressure be adopted, further increases of 715 deg. F. and 493 deg. F. could be attained. The possibility of obtaining far higher evaporative efficiencies from boiler plants, than any yet attained, by intensifying the combustion along these lines, is therefore strikingly manifest, and it is surprising that hitherto so few attempts have yet been made to put these suggestions to a practical trial in new plants or extensions.

The limit of improved efficiency possible in this direction is that imposed by the ability of the steel used for boiler construction to withstand very high temperatures under steam pressures of 150 or 200 lb.; but no doubt the resisting qualities of steel plates in this respect could be greatly improved, and the more general use of refractory linings to the boiler furnaces would [illegible]

BOILERS AND FURNACES.

The authors point out that for long-continued steady work, such as electric tramway work, the large shell type of boilers, such as the Lancashire and Marine is very suitable, that for lighting work and large installations the large water-tube boiler is a good type to use, while the small water-tube boiler is suitable for the peaks of loads of short duration, and can be [illegible]

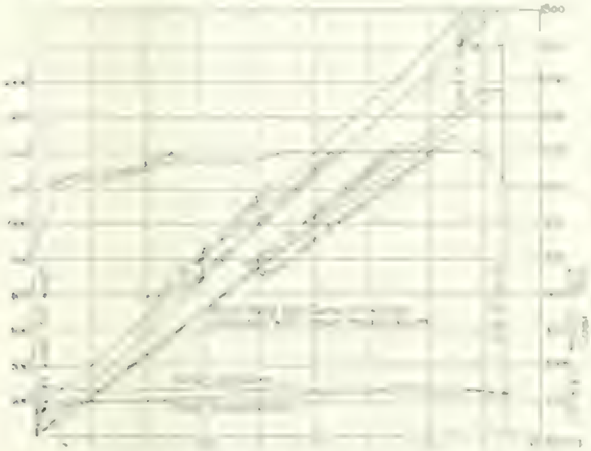


FIG. 1.—[illegible]
[illegible]

In every case there are certain stand-by losses to be reduced by attention to air-tight brickwork and heat insulation. The type of boiler to be employed is less a matter of heat storage than of rapidity of steaming from colder conditions. Once the temperature of full pressure has been attained, the boiler containing much water will answer as rapidly as the flash boiler to an increased urgency of fire. The conditions of an electric light station may be held to point to the use of light water-tube boilers of the Express type fired by liquid fuel. This policy will be the more suitable as the load peak becomes of greater height and shorter duration.

Where coal is the fuel the provision of a second supply will present difficulties that may be more serious than the provision of more boilers; but with a system of liquid fuel, the conveyance of the fuel to the furnaces is a simple matter, and it may well pay to employ expensive liquid fuel during heavy loads of short duration, if capital outlay is thereby reduced together with rent and attendance. This seems for Great Britain at least the proper use of liquid fuel. Any more general employment of liquid fuels would deplete the market and raise prices.

The Lancashire or Shell type of boiler has the advantage of small heat-radiating surfaces and whereas with most water-tube boilers there are at least two side walls to every two boilers, there are only two side walls to any number of Lancashire boilers, heat-radiation being confined to the front end and top. The chief disadvantage of this type of boiler is the furnace. For small stations the shell boiler offers better prospect of steady pressure.

Though the water-tube boiler does not possess the steady steaming qualities of the larger shell boiler, this fault decreases as the number of boilers increases. It is more apt to prime, and it has greater liability of stand-by losses, and larger radiation losses and maintenance. Being externally fired, it possesses great furnace potentialities which are easily secured. The water-tube boiler can take full advantage of the external [illegible] known facts of physics and chemistry.

The small tube boiler is merely another step forward in the process of splitting up the heating surface and reducing water contents.

[illegible] of the casing so that the full output of steam does not begin for some time. Hence the bend at the beginning [illegible] showing heat absorbed and given off by the brickwork.

These small boilers appear to offer themselves for supplying emergency steam. Fired by liquid fuel, some of these boilers, such as the Solignac, could instantly be put in full work if filled up with fully-heated feed-water from a thermal store tank. The full fire might be started almost as soon as the water had been turned into the empty boiler.

TYPES OF FURNACES COMPARED.

The economy possible from many appliances lies entirely in the possibility of using a cheaper fuel. The three essentials for the proper use of bituminous coal are a furnace so arranged that the gases given off the green fuel and air to burn those gases shall travel over the length of the fire together, under a draught velocity of not less than 30 ft. per second. The mixed gases must have free unencumbered space beyond the furnace in which to complete combustion, and this combustion will be complete if the third essential of temperature be present.

In shell boilers of the Lancashire type without cross tubes, with roomy brick flues and a 200 ft. chimney, a careful hand stoker will burn bituminous fuel without smoke.

The ordinary furnace of the usual types of water tube boiler is hopeless. No perfect combustion can possibly take place where the gases rise vertically from the grate and pass directly between the cold tubes above. The essential sweeping effect is absent; there is no air mixture, and there is no sufficient temperature.

The water-tube boiler, in common with most or all externally fired boilers, can be supplied with a furnace of perfect form, of refractory material, and with suitable air admission. Such a furnace will be smokeless and economical. The water-tube boiler has thus undoubted potential advantages over the shell boiler which has a furnace, perfect it may be in form, but covered with a water-cooled arch difficult to line with refractory temperature-conserving material (figs. 2 and 3). In existing stations, with floor lines fixed, basements occupied, and pipes difficult to alter, the change to good furnace conditions may involve considerable difficulty, but, in laying out new plant, it should be possible to afford the necessary head room to give good furnace arrangements.

In Fig. 2 is a furnace which has been shown effectually to burn bituminous coal without smoke, but, so far as the authors are aware, this furnace has only been used with ordinary chain grates, and there is no ordinary chain grate that does not pass an unnecessary and grossly excessive volume of air. Until this furnace is tried with a less wasteful form of grate, no absolute opinion can be passed upon its proportions though its principles are correct.

Fig. 5, which shows the Weir water-tube boiler, is an example of the same principle, scarcely different in the way it is carried out. Coal is burned in the Λ-shaped furnace, the walls on all four sides of which are of fire brick, and combustion is continued in a similarly protected chamber, and is perfect with ordinary hand-firing before the heated gases pass among the tubes. Fig. 6 shows the locomotive furnace similarly arranged to secure correct form. The chain grate stoker is perfect as a self-cleaning contrivance, but admits excessive air. Hence the need of choking boxes, as employed by Mr. E. B. Coxe (fig. 7).

The ideal mechanical stoker is of the inclined grate type in which the inevitable thinning of the fire of the cooking furnace is made good by the aid of a moving grate assisted by gravity. In this type, only possible in its full extent with external furnaces, the fuel is helped to fill gaps and close the lower end of the fire by gravity, and at the foot of the inclined grate is some arrangement which enables ash and dirt to be removed.

THE WASTE GASES

The temperature and chemical composition of the waste gases passing from every large boiler-plant ought to be regularly ascertained. The absence of smoke is no guarantee that combustion is being carried out in an economical manner, and only by constant testing of the exit gases can one be certain that the fuel is being burnt, without undue excess of air. The significance of air excess becomes manifest when one considers the following figures: With gases containing only 4 per cent. of CO_2 and a chimney temperature of 400 deg. F., 4,380 B.Th. units are lost for every pound of fuel burnt, *i.e.*, 32·4 per cent of the total heat value of the fuel.

Where no economiser is installed, the loss of heating power is even greater, for the gases then pass to the chimney at a temperature of from 600 deg. to 700 deg. F., and the heat losses rise to 6,750 and 7,665 B.Th. units, or to between 48 and 56 per cent. of the total heat value of the fuel.

Taking now the case where the boiler plant is under scientific control, and by constant testing the percentage of CO_2 in the exit gases has been raised to 12 per cent., the loss of heat with chimney gases at 400 deg. F. is reduced to 1,540 B.Th. units, or to 11·4 per cent. of the total heat value of the fuel.

In the one case, only between 44 and 68 per cent. of the heat can possibly be utilised; while in the other, 88·5 per cent. of the thermal value of the fuel may be converted into useful work—either in the boilers or in the feed-water apparatus.

INSTITUTE OF MARINE ENGINEERS.

PPESIDENTIAL ADDRESS BY THE HON. C. A PARSONS.

[illegible]

As to the probable development of the turbine in [illegible] present before us, Mr. Parsons thinks it safe to predict that it will soon entirely supersede the reciprocating [illegible] and of over 5,000 i.h.p., and probably also including [illegible] upwards, and possibly to still slower vessels in course of time. At the present it may be said that the above most suitable field comprises about one-fifth of the total steam tonnage of the world; but it must be remembered that the speed of ships tends to increase, and the turbine to improve, and so the class of ships suitable for the turbine will increase.

TURBINES AND TRAMP STEAMERS.

[illegible] reciprocating engine and the turbine will be found the best machinery for vessels of the tramp class in the immediate future. This field is a very large and important one, deserving of more attention than [illegible] consideration.

[illegible] 10 knots speed, the revolutions must be low, because a certain disc area of propeller and a certain number of square feet of blade area are necessary in order to avoid too great a slip ratio and consequent loss of propeller efficiency. It is also proved by experiment that the pitch ratio cannot be reduced much below ·8 without commencing to incur excessive loss from skin friction of the blades. There is no alternative but to accept the highest revolutions possible under the circumstances, which in a 10-knot [illegible]

To obtain a reasonable economy from a turbine a certain surface speed of the turbine blades is essential as well as a certain number of rows of blades. If the revolutions are low, the diameter and also the number of rows must be increased in order to maintain the economy. The result is that for ten knots the diameter and number of rows become inordinately great, the weight and cost become excessive, and also, added to this, the efficiency of the turbine is somewhat impaired by such extravagant dimensions in proportion to the power realised. Experimenters are, therefore, blocked on these lines, and must choose some other course.

Fortunately there is a way out of the difficulty by which there can be obtained the full measure of expansion essential to economy, a superior economy to the best set of tramp engines in existence. It is now quite possible to make a turbine to deal economically with very low pressure steam, and to expand this low pressure steam thereby fully and economically and yet with a turbine of moderate cost and of slow revolutions.

[illegible] is found that the steam is usefully expanded down to about 7 lb. pressure absolute, and that it is then released into the condenser and the remaining energy between 7 lb., down to say, $1\frac{1}{2}$ lb., or 27 in. vacuum is almost entirely lost. Now what the turbine can do is to save, say 70 per cent. of this wasted power, and apply it to help to drive the vessel. The additional power gained by the use of this low-pressure turbine has been calculated to be between 15 per cent. and 20 per cent. of the whole now realised, a gain of the same order as was obtained in the advance from the [illegible] feature of the case; minor points, of course, there are, such as improvements of the condenser (as a good vacuum is very essential to all turbines for the best results) and also feed-heaters fed from the exhaust of auxiliaries or low-pressure steam drawn from the main engines for heating the colder feed due to the higher vacuum; and there are also other minor points, but it is clear that some arrangement such as is indicated will be largely used for the tramp engines of the near future.

THE MARINE GAS ENGINE.

[illegible] oil engine as the possible, and, indeed, the probable and extensive competitor of the steam engine in the future. On land, the gas and oil engines have been [illegible] sumption of from half to two-thirds that of the best condensing steam engine. Unfortunately for the gas and oil engine, it cannot yet be said that they can [illegible] must yet, as a rule, have anthracite coal, coke, or oil, and the result is that as yet their fuel is about double the price of that consumed by the steam engine. There are many workers in the field, and if, in the future, some form of gas producer using ordinary [illegible] (which seems probable), and if the mechanical details [illegible] accomplish.

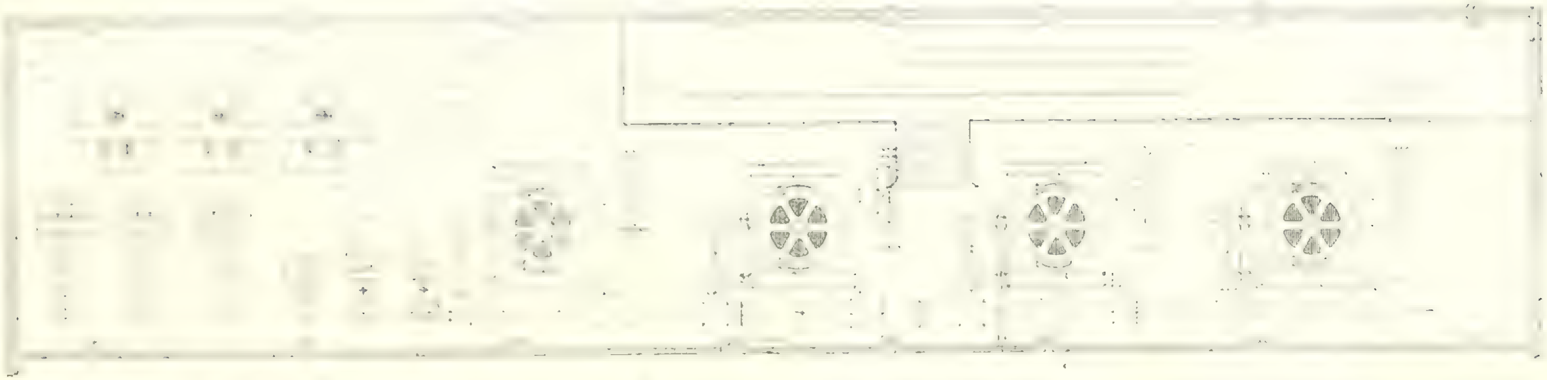


FIG. 3. PLAN OF ENGINE-ROOM, WITH FOUR 5,000 K.W. CURTIS TURBO-GENERATORS AND AUXILIARIES.

Superficial area about 10,000 sq. ft., equal to half a sq. ft. per k.w. of the main-engines.

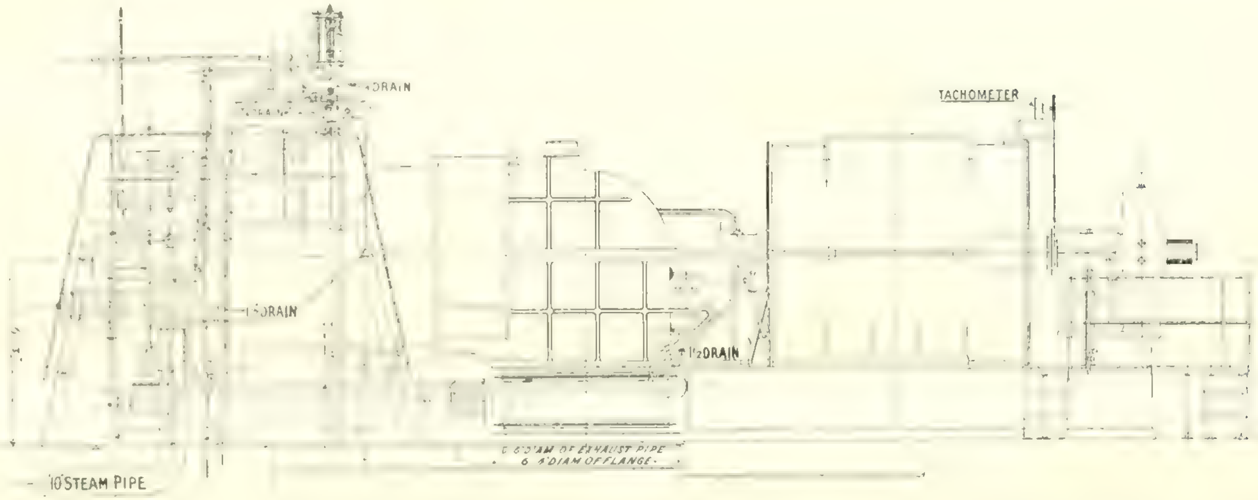


FIG. 4. 3,500 K.W. STEAM TURBINE ALTERNATOR, CONSTRUCTED BY MESSRS. C. A. PARSONS AND CO. FOR CARVILLE POWER STATION.

Weight of machine 93 tons; speed 1,200 revolutions per minute.

[illegible] precedented amount of potential energy for advance, [illegible]

[illegible] importance that marine engineers should be well versed in the machinery under their charge, and also have as much knowledge as possible of the general principles upon which the design has been based. They will [illegible] from the machinery under their charge, but also to afford [illegible] structors of machinery.

MANCHESTER ASSOCIATION OF ENGINEERS.

A COMPARISON OF DIFFERENT TYPES OF STEAM TURBINE

At the meeting of this Association held on Saturday last, Mr. R. M. Neilson read a paper on this subject.

[illegible]

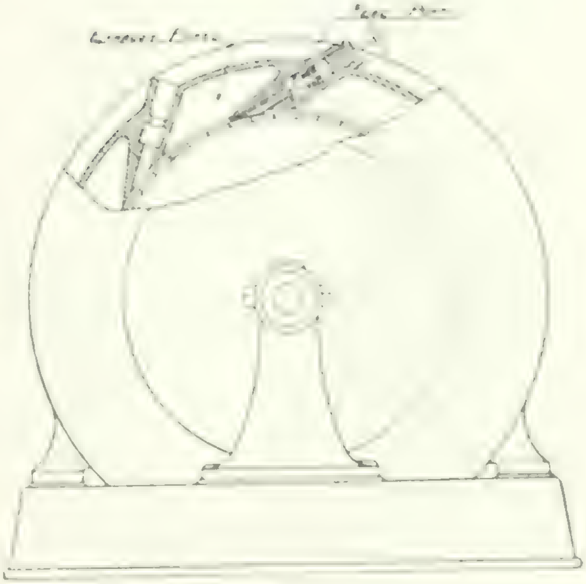
[illegible] versible steam turbine. The wheel is composed of plates of which every alternate one is scalloped out as shown, while the intervening plates are left uncut. The steam is expanded in diverging nozzles controlled [illegible] uncut plates. To reverse the turbine it is only ne[illegible] to direct the steam on to the wheel by an alternative set of nozzles inclined in the opposite direction, the wheel being equally suitable for rotating in either [illegible]

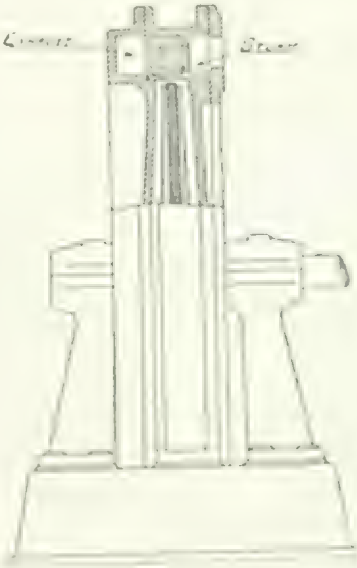
[illegible] according to the manner in which the steam is expanded. He does not approve of the division into two [illegible] tion steam turbines.

[illegible]

ENGINE-ROOM STATISTICS

[illegible]





[illegible]

Fig. 4 shows one of the two 3,500 kilowatt steam turbine alternators supplied by Messrs. C. A. Parsons and Co. to the Newcastle-on-Tyne Electric Supply Company, Ltd., for their Carville Power Station, Wallsend. The total length of the turbo-alternator is about 37 ft., or, including the platforms and the stairs or ladders leading to these about 40½ ft. The extreme breadth is about 11½ ft., and the extreme height about 14½ ft. The weight of the machine is 93 tons, and the speed of rotation 1,200 revolutions per minute. The two machines are arranged side by side with their centre lines 26 ft. apart. This gives a space of an average width of about 12 ft. between the machines and the rectangle required by the two machines, and this intervening space amounts to about 1,357 square feet ([illegible]).

The dimensions, weights, and some other particulars of turbines of several different types are given in the Table where they can be compared. The engine-room floor works out at two-thirds square feet per kilowatt of the main engines. The Brown-Boveri-Parsons horizontal machines have 33·3 per cent. more ground than the vertical Curtis machines. There is no doubt that the vertical arrangement of the Curtis turbine gives it an advantage as regards floor space required, but on the other hand it calls for greater head room. Whether a power house for large vertical Curtis turbines can be constructed cheaper than one for turbines of equal power of the Parsons type is a question the answer to which is not by any means obvious.

HOW TO SECURE STEADY RUNNING.

Four methods are employed for getting steam turbines to run steady: (1) By keeping the angular velocity below the critical speed; (2) By running the machine above its critical speed, but providing yielding bearings to allow the rotating mass to choose its own axis of rotation; (3) By running the machine above its critical speed, but mounting the rotating mass on a flexible shaft to allow it to choose its own axis of rotation; (4) By running the machine above its critical speed, but balancing the rotation mass to kill vibration.

The first method is commonly adopted in large power turbines. The second method is adopted in the smaller Parsons turbines. The third method is adopted in the De Laval turbine, and in the higher speed Zoelly turbines. The fourth method is generally adopted in Riedler-Stumpf turbines.

The power and the steam consumption of a steam turbine can be reduced by reducing the aggregate area of the first nozzles or steam passages directing the steam on to the first set of moving vanes; by reducing the density or temperature of the steam supplied to these nozzles or passages; by reducing the time during which these nozzles or passages are passing steam; or by raising the exhaust pressure.

The first method is adopted in the De Laval, Rateau, Curtis, and Riedler-Stumpf turbines, the second in the Zoelly turbine, the third in the Parsons' turbine, while the last method could be advantageously employed with condensing turbines.

-Particulars of Steam Turbines of different Types.

Machine and Maker.	Rated Power	Greatest Vane speed in feet per sec.	K.E. in rotating parts Flywheel capacity.	Floor Space		Height in feet.	Weight in Tons.	Revs. per minute.
				Area in sq. ft.	Lgth & Bdth in feet			
[illegible] Makers The Westinghouse Machine Co.	5,500 k.w.	350			Lgth 45·8 Bdth 13·2	14	268 with generator 176 without ,,	750
[illegible] turbo-alternator for Power Station [illegible] Compagnie [illegible] Française de [illegible] Tramways at St Denis, France	5,000 k.w.	262	3,203,125 kg metres		Lgth 47·5 Bdth 13·5	11	150	750
[illegible] supplied by Messrs C A Parsons [illegible] Carville Power Station of the [illegible] Tyne Electric Supply Co Ltd	3,500 k.w.				Lgth 37 Bdth 11·5	14·5	93	1,200
[illegible] turbo-alternator at the Pearl Street Station of the Hartford Electric Light Co., Hartford [illegible] U.S.A. Makers The Westinghouse [illegible]	1,500 k.w.				Lgth 33·25 Bdth 8·75		78	
[illegible] Thomson Houston [illegible]	1,500 k.w.						78, including condensing plant	1,000
[illegible] of The Brush Electrical Engineering Co., Ltd. Turbine of the Parsons type ..	1,000 k.w.	350	3,500,000 ft. lbs without alternator	124 turbine only without alternator	Lgth 15·5 turbine only without alternator.		15 approx. without alternator.	1,500
[illegible] turbo-alternator at Power [illegible] Westinghouse Air Brake Co. [illegible] U.S.A. Makers The Westinghouse Machine Co. ..	[illegible] k.w.			75		7·75	11·2	3,600
[illegible] C. A. Parsons & Co.	250 k.w.							3,000
De Laval [illegible] of Messrs [illegible] Ltd	300 B.H.P.	1,378			Lgth 15·75 Bdth 6·916	5·5	11·5	750

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts

CONTRACTS OPEN.

Bamford. [illegible] Mr. [illegible] ... [illegible]

Grimsby. [illegible] Mr. W. A. Vignoles, Corporation Electricity Works, [illegible] ... [illegible]

Swindon.—Supply and erection of Lancashire boiler with downtake superheater, etc., for Corporation. Mr. J. G. Griffin, [illegible] Works, Swindon ... [illegible]

South Indian Railway [illegible] Mr. [illegible] Managing Director, 55, Gracechurch Street, E.C. ... ... [illegible]

Netherlands. [illegible] steel, general ironware, corrugated galvanised soft steel sleepers, metal superstructures for bridges, etc. ... ... [illegible]

Cardiff.—Construction of sewerage disposal works, supply and erection of gas engines etc., for the Llandaff and Dinas Powis Rural District Council. Mr. H. Warren, Clerk, Park Place, Cardiff ... ... [illegible]

Harrogate. — Supply and delivery of welded steel pipes and other materials in [illegible], to be delivered at Ripley Station of the North-Eastern Railway. Mr. Edward Wilson Dixon, Engineer, Albert Street, [illegible] ... [illegible]

Bradford.—Supply of steel girder, tramway rails, fishplates, steel poles. etc. Mr. Frederick Stevens, Town Clerk ... ... Jan. 28

Chertsey. [illegible] S.W. ... [illegible]

Ebbw Vale.—Construction of Carno reservoir (three contracts). Engineer, Mr [illegible] ... [illegible]

Halifax [illegible] Committee. Mr. W. M. [illegible] Borough Electrical Engineer, [illegible] ... [illegible]

Manuden.—Erection of an iron girder [illegible] Council. Mr. Chas. Hicks, Surveyor, [illegible] ... [illegible]

Salford. [illegible] ... [illegible]

Handsworth. — Supply and delivery of power and lighting circuits and fittings for generating station (Contract 10), Pipework, Feed-pumps, Economiser (Contract 11), electricity meters (Contract 12). Mr H. [illegible] ... [illegible]

Kirkcaldy.—An extension of about 500 ft. to present East Pier for the Town Council. Mr. Wm. L. Macendoe, Town Clerk ... Feb. 4

Woking.—Supply and erection of steel gasholder and steel tank for the Woking District Gas Company. Mr. B. Dennett Holroyd, Secretary, 5 and 6, Great Winchester Street, E.C. ... ... Feb. 11

Nottingham.—Construction of reservoir at Wilton Hill. Mr. F. W. Davies, Water Engineer, Water Offices, St. Peter's Square Feb. 13

South Shields. Execution of works and supply of plant in connection with the construction of overhead electric tramways. Mr. J. Moore Hayton, Town Clerk. Feb. 20

Brisbane.—Supply of steel rails and steel fishplates. Agent-General for Queensland 1, Victoria Street, S.W. ... ... Mar. 7

Lulea (Sweden).—Widening and deepening of the Channel, "Trufholssundet," at Lulea. Harbour Commissioners, Lulea, will supply particulars ... ... April 1

Bermuda. [illegible] buoying of the channel leading from sea into St. George's Harbour, in the Islands of Bermuda. Particulars of Messrs. Coode, Son and Matthews, 9, Victoria Street, S.W. Tenders to Crown Agents [illegible]

COMING CONTRACTS.

Anstruther. [illegible]

Natal. [illegible] text of a [illegible] current.

Switzerland. [illegible]

Austria Hungary. [illegible]

Cape Town.—Extensive contracts for tramway plant, and equipment are foreshadowed under the scheme now under consideration for constructing an electric tramway from Cape Town, linking up the municipal areas of Woodstock and Maitland.

Admiralty.—The Admiralty have sent out invitations to [illegible] English firms to submit tenders for the construction of five torpedo boats to be 165 ft. long and to have a speed of 25 knots.

Barrow-in-Furness.—The Local Government Board has sanctioned the borrowing by the Town Council of £35,000 for electric supply purposes.

Macclesfield.—The Town Council is applying for permission to borrow £15,000 for an electric supply scheme.

Barking.—Application is to be made for a loan of about £9,000 for electric supply extensions.

Maidstone.—The Corporation are raising £25,000, as authorised by the Maidstone Corporation Light Railway Order, 1903.

Upton-on-Severn.—The Council are applying for sanction to a loan of £6,000 for carrying out sewerage works.

Dover.—Works are to be put in hand at once in connection with the fall of cliff in St. Margaret's Bay, and with the view to preventing further coast erosion.

Yarmouth.—Application is to be made for a loan of £10,000 for new plant, including another 300-k.w. engine and dynamo and boilers at £4,500, and an additional water conduit, estimated to cost £3,500. The Corporation propose spending £56,000 on electric tramways.

Turin.—An amount of 40,000,000 francs is to be expended in improvements which include a powerful hydro-electric plant and a new aqueduct.

District Railway.—The Metropolitan District Railway Company in their new Bill seek for power to raise £400,000 towards the general purposes of the undertaking, the cost of adapting the railway for electrical working, etc.

CONTRACTS CLOSED.

Underground Electric Railways.—The Underground Electric Railway Company of London has placed an order with the Sir Hiram Maxim Electrical and Engineering Company, for a large number of "Maxim" direct-current traction circuit arc lamps.

Swansea.—The tender of the British Insulated and Helsby Cables, Ltd., for telephone cables and extensions to switchboard has been accepted by the Telephone Committee.

Canterbury.—The Council has accepted tenders from Dick Kerr and Co., Ltd., for 300 k.w. steam dynamo from Davey, Paxman and Co., for boiler and superheater, from J. G. Statter and Co., for switchboard, from E. Green and Sons, for extensions to economiser, and from E. J. Philpott for electric wiring.

West Ham.—The Corporation has accepted tenders from Babcock and Wilcox, Ltd., from Ferranti, Ltd., from the British Thomson-Houston Company, Ltd., and from Windsor and Co., for boiler work and electrical equipment.

Whitby.—The District Council has accepted the tender of C. A. Parsons and Co., for a 200-k.w. steam tur[illegible]

South Africa.—A steam crane to cost about £15,000 is being built by Messrs. Cowans Sheldon and Co. Ltd., of Carlisle, for shipment to South Africa.

Derby.—The tender of J. G. White and Co., Ltd., for tramway extension has been accepted at a price of £3,000.

Glasgow.—The Mirrlees Watson Company Ltd., of Glasgow, have recently received orders for condensing plants from the following: British Thomson-Houston Company for County of London Electric Supply Corporation; Alfred Parry, Manchester, for Calcutta; Trafford Power and Limited Supply Company, Manchester, per Lacey Sillar and Leigh; J. and P. Coats, Ltd., for Barcelona, British Thomson-Houston Company for London; Crewe Electricity Works, Gwynnes Ltd., London.

APPOINTMENTS VACANT.

	Last Day.
Calcutta.—Assistant Engineer to the Port Commissioners. Salary Rs. 450 per month. Applications to the Commissioners' London agent, Mr. J. H. Apjohn, 17, Victoria Street, Westminster, S.W. ...	Jan. 24
Ripley.—Gas Works Manager. Applications to Secretary, Gas Works, Ripley, Derby...	Jan. 30
Luton.—Borough Engineer and Surveyor. Applications to Mr. G. Sell, Town Hall, Luton ...	Jan. 31
Battersea.—Borough Electrical Engineer. Salary, £400 per annum. Applications to Mr. W. Marcus Wilkins, Town Clerk, Lavender Hill, S.W....	Jan. 31
Sligo.—Harbour Engineer. Salary, £200 per annum. Applications to Mr. T. J. Mercer, Harbour Office, Sligo ...	Feb. 15
Manchester.—Professor of Engineering in Victoria University. Salary, £1,000 per annum. Applications to Registrar at the University ...	Feb. 15

APPOINTMENTS FILLED.

Liverpool.—Mr. S. W. Shakespear has been appointed at a salary of £700 per annum, to succeed Mr. G. B. Proctor as chief traffic manager to the Liverpool Dock Board, the latter having retired.

Macclesfield.—Mr. William Newbigging, of Manchester, has been appointed to the position of gas engineer to the Macclesfield Corporation, at a salary of £300 per annum.

Hindley.—Mr. Oswald P. Abbott, has been appointed engineer and surveyor to the Hindley (Lancs.) Urban District Council.

Johannesburg.—Mr. G. S. B. Andrews, deputy town engineer, has been appointed engineer at a salary of £1,800 per annum.

Exeter.—Mr. Hederstead has been appointed chief officer of tramways to the Exeter City Council at a salary of £400 a year. Mr. Hederstead has been in the service of the London County Council.

Millwall Dock Company.—The directors of the Millwall Dock Company have elected Mr. F. E. Duckham, M.Inst.C.E., to a seat on the board on his retirement from the position of general manager and engineer of the company, and have appointed Mr. W. S. T. Biggs and Mr. George Hazlehurst joint managers, these two gentlemen still retaining their present positions of secretary and superintendent respectively. Mr. Magnus Mowat, jun., late assistant engineer, has been appointed engineer to the company.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

[illegible]

[illegible]

I.—ENGINEERING, IRON, AND STEEL COMPANIES

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. 4% Cum. Pref. ..	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Baldwins, Ltd., 5½% Cum. Pref. ..	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Barrow Hæmatite Steel Co., Ld., O	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. do. Cum 2nd. Pref	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	100	98 —100
[illegible]	[illegible]	[illegible]	Bolckow, Vaughan and Co., Ltd., O	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. Nos. 1,659,101-3,500,000	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Brown (John) and Co., Lim., Ord.,	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. Ord., Nos. 1,160,001-1,750,000	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Cammell, Laird & Co., Ltd., Ord. ..	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] Ltd., Ord.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] Ltd., Ord. ..	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. do. do.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]ott's Metal, Ltd.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] Pref. ..	5	[illegible]
250,000	[illegible]	[illegible]	[illegible] Ltd., Ord.	1	[illegible]
20,000	10	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] Pref...	[illegible]	[illegible]
85,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

ENGINEERING, IRON AND STEEL COMPANIES—[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Kynoch, Ltd.	10	[illegible]
[illegible]	10	[illegible]	Do. Cum. [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] Ltd. [illegible]	1	[illegible]
[illegible]	[illegible]	[illegible]	Do. 5½% Cum. Pref ..	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Leeds Forge Co., 7% Cum. Pref. ..	[illegible]	[illegible]
[illegible]	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	[illegible]
[illegible]	Stk	[illegible]	Do. 4½% 1st Mt. Deb. Stk., Red.	100	108 —110
40,000	10	5/-	[illegible]	10	11 — 11½
210,000	1	6d.	[illegible]	1	[illegible]
75,000	1	[illegible]	Do. [illegible]	1	[illegible]
£75,000	Stk	[illegible]	Do. 4½% 1st Mrt. Db. Stk., Red.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Muntz Metal, Ltd.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. Pref. 5%	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	73 — 7[illegible]
73,000	10	5/-	N. Brit. Loco. Co., [illegible]	10	11½ [illegible]
80,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
£250,000	[illegible]	[illegible]	[illegible]	100	[illegible]
122,000	[illegible]	2/-	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	3/-	[illegible]	[illegible]	[illegible]
70,000	10	6/-	[illegible]	10	[illegible]
[illegible]	5	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. 5% Mort. Deb., Red. ..	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	10	[illegible]
[illegible]	1	[illegible]	[illegible]	[illegible]	⅞ — 1
[illegible]	1	[illegible]	Do. do. Cum. Pref. ..	[illegible]	1 — 1½
£115,300	100	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	[illegible]	[illegible]	1	[illegible]
[illegible]	[illegible]	[illegible]	Do. [illegible]	[illegible]	[illegible]
[illegible]	10	[illegible]	Stephenson (Rober[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	76 [illegible]
[illegible]	10	[illegible]	[illegible]	[illegible]	18 [illegible]
25,000	10	[illegible]	[illegible]	[illegible]	14 [illegible]
300,000	1	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

II.—ELECTRICAL MANUFACTURING COMPANIES.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	[illegible]
[illegible]	1	[illegible]	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	[illegible]
120,000	1		[illegible] Asbestos Co., Ltd.	1	[illegible]
[illegible]		[illegible]	British Insulated [illegible] Cables Ltd., Ord.	[illegible]	[illegible]
[illegible]		[illegible]	Do. [illegible] Cum. Pref.	5	[illegible]
[illegible]	[illegible]	[illegible]	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 —104
[illegible]	[illegible]	[illegible]	British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Stk. Red. ...	100	101 —103
400,000		3/-	British Westinghouse Electric and Manufac. Co., Ltd., 6% Pref. ..	5	[illegible]
[illegible]	[illegible]	[illegible]	Do. 4% Mort. Deb. Stk. Red...	100	[illegible]
[illegible]	[illegible]	[illegible]	Brush Elec. Enging. Co., Ltd., Ord..	[illegible]	[illegible]— ⅞
[illegible]	2	1	Do. [illegible] Pref.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. [illegible] 1st Deb. Stk.	100	[illegible]
[illegible]	Stk	[illegible]	Do. 4½% Perp. 2nd Deb. Stk.	100	[illegible]
35,000			Callender's Cable & Constn. Ltd. Ord.		9 — 10
[illegible]	[illegible]	[illegible]	Do. [illegible] Cum. Pref.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. 4½% 1st Mort. Deb. Stk. Red.	100	104 —106
[illegible]	[illegible]	[illegible]	Crompton & Co., Ltd.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. [illegible] 1st Mort. Reg. Debs.	100	[illegible]
[illegible]	[illegible]	10/-	Dick, Kerr & Co., Ltd., Ord.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. [illegible] Cum. Pref.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. 4½% Deb. Stock, Red. ..	100	105 —107
[illegible]	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref	1	[illegible]
[illegible]	[illegible]	4%	Do. [illegible]	100	105 —108
[illegible]	[illegible]	[illegible]	Edison and Swan United Electric Light, Ltd., "A" Shares [illegible]		
[illegible]	[illegible]		Do. "A" Shares Nos. 01-017,139	[illegible]	1
[illegible]	Stk	[illegible]	Do. [illegible] Deb. Stock, Red.	100	[illegible]
[illegible]	[illegible]	[illegible]	Do. [illegible] Red.	100	[illegible]
[illegible]	2	[illegible]	Electric Construction Co., Ltd. ..	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. [illegible] Pref.	2	[illegible]
[illegible]	Stk	[illegible]	Do. [illegible]	100	[illegible]
[illegible]	[illegible]	7/-	Evered and Co., Ltd.	10	13 — 15
[illegible]	Stk	[illegible]	Ferranti, Ltd., 5% 1st Mort. Deb. [illegible]	100	90 — 95
[illegible]	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% [illegible]	10	[illegible]
[illegible]	[illegible]	[illegible]	Do. 4% 1st. Mt. Deb. Stk., Red.	[illegible]	91 — 96
[illegible]	[illegible]	[illegible]	[illegible] Co., Ltd., Ord.	[illegible]	10¼ — 10[illegible]
35,000	[illegible]	[illegible]	Do. 4½% Cum. Pref.	[illegible]	[illegible]
[illegible]	Stk	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	5/-	[illegible] Telegraph Works Co., Ltd.,	10	15 — [illegible]
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	[illegible]	[illegible] 102
[illegible]	10	[illegible]	[illegible]	10	[illegible] — 7
[illegible]	12	[illegible]	Telegraph Construction and Maintenance Co., Ltd.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. 4% Deb. Bonds	[illegible]	[illegible]

III.—ELECTRIC TRACTION.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	5	[illegible]
[illegible]	[illegible]	[illegible]	Do. 5% Cum Pf.	5	[illegible]
[illegible]	Stk	[illegible]	Do. Permanent 6% Debenture Stock, 1888 ..	100	[illegible]
20,000	[illegible]	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	[illegible]
[illegible]	10	5/-	Do. 5% Cum Pf. Shares	10	9 — 10
[illegible]	100	[illegible]	Do. 5% Debs., Red. ..	100	99 — 102
£[illegible]	[illegible]	[illegible]	Do. 4½% Red. Deb. Stk.	100	[illegible]
[illegible]	1	[illegible]	Bath Elec. Trams. Ld., Pf. Or.	1	[illegible]
[illegible]	[illegible]	[illegible]	Do. 5% Cum. Pf. ..	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] Co., Ltd., Ord.	[illegible]	[illegible]
75,000	[illegible]	[illegible]	Do. 5% Cum. Pf.	[illegible]	[illegible]
[illegible]	Stk	[illegible]	Do. 4½% 1st Deb. Stk., Red.	100	[illegible]
£200,000	[illegible]	[illegible]	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	100 — 103
			Pref. Ord. Stock ..	100	100 — 103
[illegible]	[illegible]	[illegible]	[illegible]	10	10 — 10[illegible]
[illegible]	10	[illegible]	[illegible]	10	102 — 104[illegible]
[illegible]	[illegible]	[illegible]	Do. 4½% Vancouver Power Db.	[illegible]	97 — 100
[illegible]	10	[illegible]	Brit. Electric Traction, Ltd., Ord.	10	[illegible]
156,147	10	[illegible]	[illegible]	10	11 — [illegible]
£1,000,000	[illegible]	[illegible]	Do. 5% Perp. Deb. Stk.	100	118 — 120
[illegible]	[illegible]	[illegible]	Do. 4% 2nd Deb. Stk. Red..	[illegible]	[illegible]
100,000	[illegible]	[illegible]	[illegible] Trams, Ltd., Ord.	[illegible]	[illegible]
[illegible]	[illegible]	3/-	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	3/-	Do. "B" do.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] Ltd., 5% Db. Stk., Red.	100	[illegible]

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares	Last Dividend	Name	Paid up.	Closing Prices.
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	98 —101
102,268	5	3/-	Calcutta Tramways Co., Ltd. .	[illegible]	8⅝— 8⅞
£[illegible]	Stk	[illegible]	Do. 4½% 1st Deb. Stk., Red.	100	106 —108
480,000	1	6d.	Cape Electric Tramways, Ltd.	1	[illegible] 1⅛
40,000	[illegible]	[illegible]	City of Birmingham Trams Co., Ltd. 5% Cum. Pref.	5	[illegible]
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	98 —102
[illegible]	5	4/-	City of Buenos Ayres Trams. Co., Ld.	5	10[illegible] 10½
£116,000	Stk	[illegible]	Do. Per. 6% Deb. Stk...	100	140 —145
£120,000	Stk	[illegible]	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 —104
[illegible]	10	[illegible]	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	1[illegible] 14
[illegible]	10	6%	Do. 6% Pref. .	10	15 — 16
30,000	[illegible]	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	[illegible] 4
£150,000	Stk	[illegible]	Do. 4% Deb. Stock..	100	90 — 93
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10[illegible]
£1,031,000	Stk	[illegible]	Do. 4% 1st Mort. Deb. Stk. Red	100	103 —105
£50,000	Stk	[illegible]	Madras Electric Trams (1904), Ltd., Deb. Stock, R.	100	101 —103
314,016	1		Metropolitan Elec. Trams, Ltd., Def.	1	[illegible]
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	[illegible] 1
£350,000	Stk	[illegible]	Do. 4½% Deb. Stock, Red.	100	102 —104
50,000	[illegible]	[illegible]	New General Traction Co., Ltd., [illegible]	5	[illegible] 1¼
110,923	[illegible]	[illegible]	North Metropolitan Tramways Co..	[illegible]	4¼ [illegible]
£150,000	100	[illegible]	Do. 3½% Mort. Debs.	100	90 — 95
£196,200	Stk	[illegible]	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red	100	101 —104
[illegible]	10	[illegible]	Potteries Elec. Traction Co., Ld., Or.	10	8 — 9
[illegible]	10	[illegible]	Do. 5% Cum. Pref. ..	10	8½— 9½
£220,000	Stk	4½	Do. 4½% Deb. Stk., Red	100	99 —102

IV.—ELECTRIC LIGHTING AND POWER.

[illegible] Subscribed	[illegible]	Divi[illegible]	[illegible]	[illegible] up.	[illegible] Prices.
[illegible]	[illegible]	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	[illegible]
7,500	10	4/6	Do. [illegible]	10	9½— 10
7,500	10	6/-	Do. 6% [illegible] Pf.	10	11 — 12
£70,000	Stk	[illegible]	Do. 4½% Deb. Stock Red ..	100	102 —104
14,000	[illegible]	[illegible]	[illegible]	5	[illegible]
£50,000	Stk	[illegible]	Do. do. 4½% 1st Deb. Stk. Red.	100	101 —104
27,507	[illegible]	[illegible]	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	[illegible]	10[illegible] 11
[illegible]	[illegible]	[illegible]	Do. 7% Cum. Pref. Shares..	[illegible]	[illegible] — 10¼
60,000	5	[illegible]	Calcutta Elec. Sup. Cor. Ltd., Ord .	[illegible]	8½— 8¾
[illegible]	Stk	[illegible]	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	105 — 108
[illegible]	[illegible]	[illegible]	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	[illegible]	[illegible]
10,000	[illegible]	[illegible]	Do. [illegible]	[illegible]	[illegible]
80,000	[illegible]	[illegible]	Do. do. 4½% Cum. Pref. .	[illegible]	[illegible]
£350,000	Stk	[illegible]	Do. [illegible]	[illegible]	101 —103
40,000	5	[illegible]	Do. do. "City Undertaking" [illegible]	[illegible]	[illegible]
40,000	5	[illegible]	Do. [illegible]	[illegible]	[illegible]
44,136	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	[illegible]	6⅞— 7
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	[illegible]	[illegible] —110
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O.	10	11 — 11[illegible]
40,000	10	[illegible]	Do. [illegible]	10	13¾— 14
£400,000	Stk	[illegible]	Do. 5% Deb. Stk., Red ..	100	121 — 12[illegible]
£300,000	[illegible]	4½%	Do. [illegible]	100	101 —103
40,000	10	[illegible]	County of London Elec. Supply Co., Ltd., Ord.	10	[illegible] — 9¼
30,000	10	[illegible]	Do. 6% Cum. Pref.	10	12 — 12½
£100,000	Stk	[illegible]	Do. 4½% Deb. Stk., Red. ..	100	107 —110
[illegible]	[illegible]	[illegible]	Do. 4½% 2nd Deb. Stk., Prv. Crts. all paid, Red	100	101 — 103
70,000	5	[illegible]	Edmundson's Elec. Cor. Ltd., Ord	[illegible]	6⅛ — 6½
70,000	5	3/-	Do. 6% Cum. Pref.	[illegible]	6 — 6¼
£300,000	[illegible]	[illegible]	Do. [illegible]	100	106 —108
£80,000	[illegible]	[illegible]	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86 — 91
19,000	[illegible]	[illegible]	Folkestone Elec. Supply Co., Ld., O	[illegible]	5¼— 6
£50,000	Stk.	[illegible]	Do. 4½% 1st Deb. Stk., Red.	100	102 —105
15,000	10	[illegible]	[illegible]	10	9¾— 10[illegible]
13,000	[illegible]	[illegible]	Hove Elec. Lighting Co., Ltd., Ord.	[illegible]	7¼ [illegible]
£50,000	[illegible]	[illegible]	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100—102
[illegible]	1	[illegible]	[illegible] Electric Light [illegible] ing Corp, Ltd., 6% Cum. Pref.	1	[illegible]
[illegible]	5	[illegible]	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12[illegible]— 13

[illegible] dividend.

ELECTRIC LIGHTING AND POWER—contd.

[illegible]

V.—TELEGRAPH & TELEPHONE COMPANIES

[illegible]

TELEGRAPHS AND TELEPHONES—contd.

Western Telegraph Co., Ltd.

[illegible]

VI.—SHIPPING COMPANIES

[illegible]

VII.—MISCELLANEOUS COMPANIES

[illegible]

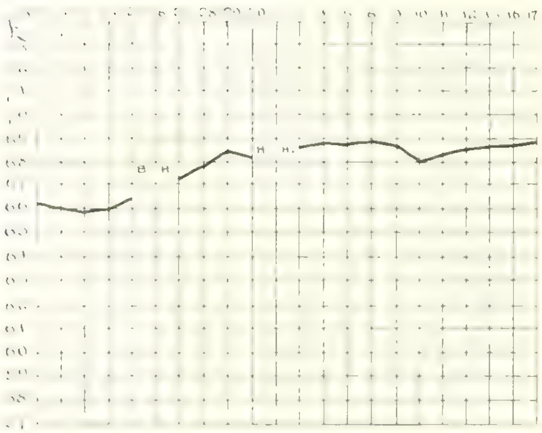
RAILWAY CARRIAGE & WAGON COMPANIES

[illegible]

THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM DECEMBER 19TH, 1904, TO JANUARY 17TH, 1905.

COPPER.



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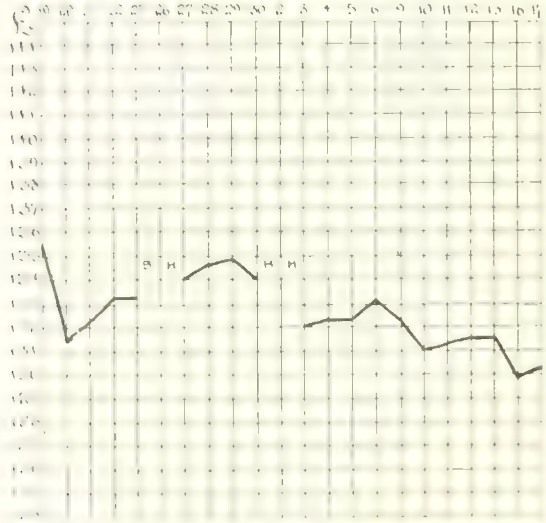
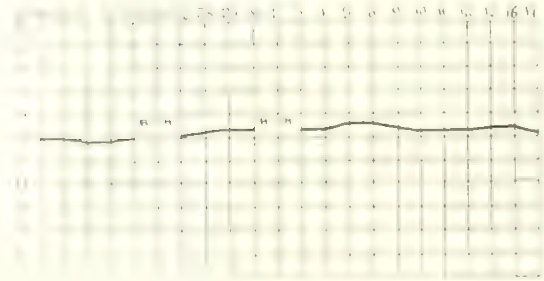
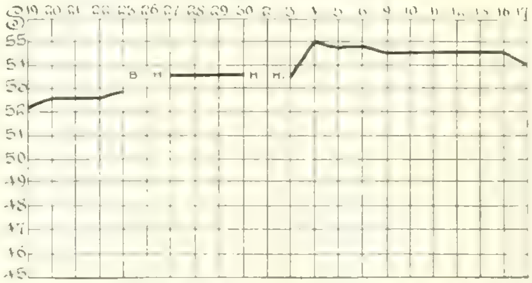


ENGLISH LEAD.



PIG IRON: SCOTCH,



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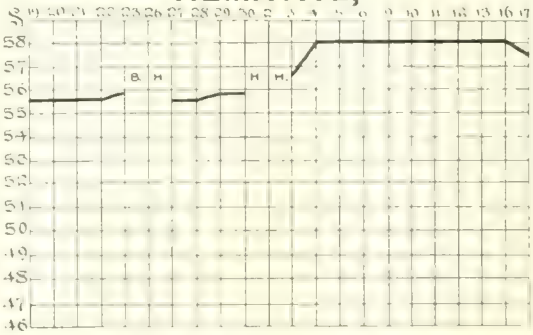
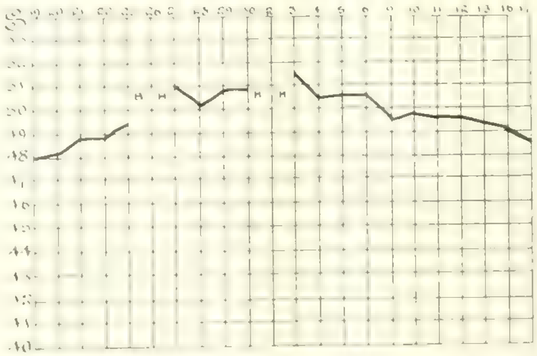
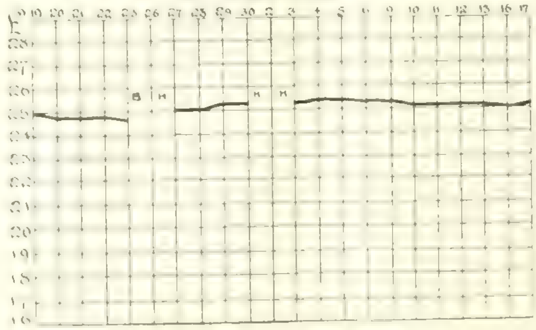


CLEVELAND.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, January [illegible]

THE [illegible] to see what is to prevent the market going higher. Messrs. Morrison, Kekewich and Co., who are not prone to taking extreme views, state that copper is in a dangerously strong position. Messrs. Merton and Co., point out that as producers are very well sold for the next month or two, they can look on indifferently and await further developments. The price closed yesterday [illegible]

Tin is recovering from a fit of depression, when under the influence of large realisations and bear pressure prices at one time receded for cash to £131. There is however a distinct scarcity of supplies for prompt delivery, and with the coming Banca sale exercising its influence, the position of tin is sufficiently strong to suggest the belief that the market will see quotations higher in the immediate future. English closed yesterday [illegible]

The Iron and Steel market has shown some irregularity but the demand for pig iron remains steady, and with prospects of increasing business makers are showing an inclination to put additional furnaces in blast. The Glasgow market for pig-iron warrants has been firmer on good advices from the States, where stocks are being largely drawn upon, and on reports of shipbuilding [illegible]

Lead has been rather a dull spot, the large arrivals having kept prices at a low level, but there has been some [illegible]

There is little fresh to record in connection with Spelter. Producers are so well sold that they have again raised their prices and quote only for distant delivery. [illegible]

The Coal market shows a tendency towards higher prices particularly in the case of steam descriptions, the the Admiralty requirements for the near future being of a heavy character. On the strike in Westphalia there is [illegible]

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as [illegible]

Steel:

	£	s.	d.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Manufactured Iron:

Bars—[illegible]

	£	s.	d.
[illegible]	6	15	[illegible]
[illegible]	[illegible]	[illegible]	6
[illegible]	[illegible]	[illegible]	[illegible]
Best Angle	6	[illegible]	[illegible]
Best Best ...	[illegible]	[illegible]	6
[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

The Glasgow Iron and Steel Co., Ltd., Wishaw, [illegible]

		£	s.	d.
[illegible]		[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]
[illegible]	♛ ♛	6	17	6
[illegible]	♛ ♛	[illegible]	[illegible]	[illegible]
[illegible]	♛ ♛	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

John Spencer (Coatbridge) Ltd., Phoenix Iron works, Coatbridge, N.B. [illegible]

Bars—[illegible]

	£	s.	d.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

	£	s.	d.
Angles—Phœnix	6	5	0
,, Best	6	15	0
,, Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix			
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:	No. 1. £	s.	d.	No. 3. £	s.	d.
Coltness f.a.s. Glasgow	3	5	0	2	15	0
Gartsherrie ,,	2	19	6	2	14	6
Summerlee ,,	2	19	6	2	14	6
Carnbroe ,,	2	15	6	2	13	0
Langloan ,,	3	4	0	2	15	0
Calder ,,	2	19	0	2	14	6
Clyde ,,	2	19	0	2	14	6
Glengarnock, f.o.b. Ardrossan	2	19	0	2	13	6
Eglinton ,, ,,	2	15	0	2	13	0
Dalmellington, ,, Ayr	2	15	0	2	13	0
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works:—**

	£	s.	d.
W.W. Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
[illegible] Nail Strips	6	15	0
W.W. Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
To Lloyd's Requirements Limited	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington.

	Iron. £	s	d.	Steel £	s.	d.
Crown [illegible]	6	10	0	7	0	0
[illegible]	7	0	0	7	10	0
[illegible]	7	10	0	8	0	0
(W I W) Hoop	7	0	0	7	10	0
[illegible]	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

	Singles 20 G 96in. by 36in. per ton. £	s.	d.	Doubles 21 G to 24 G 96in. by 36in. per ton. £	s.	d.
Black Sheets:						
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton. £	s.	d.	Doubles 21 to 24 G to 96 by 36in. per ton. £	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.
Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.
Extreme sizes in Tin and Patent Coated specially quoted for.
Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.
At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	7	6	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
Tees	7	0	0	,,
,, Best	7	10	0	,,
Best Shoe Iron	8	0	0	,,
,, Rivet Iron	8	0	0	,,
,, Best Rivet (Special)	9	5	0	
,, Cable	9	5	0	,,
,, Screwing	8	5	0	,,

	£	s.	d.	
[illegible]	8	0	0	per ton
[illegible]	8	5	0	
Best Best	[illegible]	5	0	
Treble [illegible]	10	[illegible]	0	
[illegible]	7	10	0	
[illegible] Plates	8	0	0	
[illegible] Plates	8	10	0	
,, Best Boiler Plates ...	9	10	0	
Treble Best Boiler Plates ...	12	0	0	

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., [illegible]

Discounts—

45 per cent off 1 inch to [illegible] rose and all [illegible] and [illegible].

40 per cent off [illegible] to 7 inch strong rose and [illegible] and [illegible].

40 per cent off all sharp-pointed nails.

[illegible] Extra 2½ per cent discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 9/3 per cwt.
[illegible] d/d any Railway Station

Steel cut nails, 3-inch basis—

2 tons [illegible] per cwt.
[illegible] per cwt. d/d any Railway Station

[illegible] £7 10s. per ton [illegible] for 2 ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, [illegible]

Coke Tin-plates.	Per box f.o.b Wales. £	s.	d.
C [illegible] 14 [illegible] 110 [illegible]	0	13	0
C 20 by 10 225s 155 ,, "[illegible]" ...	0	18	3
C [illegible] 14 112s 108 ,, "Lydbrook" ...	0	12	6
C 28 by 20 112s. 216 ,, "Lydbrook" ...	1	[illegible]	[illegible]
Charcoal Tinplates:			
C [illegible] 14 112s 108 lb [illegible] ...	0	1[illegible]	3

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

Steel:		£	s.	d	
Blooms ...	at	3	12	0	per ton.
Billets ...	at	3	14	0	
[illegible]	at	[illegible]	16	0	
Finished Steel:					
[illegible]	at	4	17	6	per ton.
[illegible]	at	4	18	6	
[illegible]	at	5	0	0	
[illegible]	at	4	10	0	,,
[illegible]	at	5	1	0	
[illegible] Bars	at	5	2	0	
[illegible]	at	5	4	0	
Half [illegible] Bars	at	5	5	0	
Heavy Rails	at	4	0	0	
Light Rails ...	at	4	17	6	

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. ... Dis 1½% & 1[illegible]	1[illegible]	0	0	to	131	0	0	per ton
English Bars, f.o.b. ... Dis 1½% & 1[illegible]	1[illegible]	0	0	to	1[illegible]	10	0	
Straits G.M.B., [illegible] Warehouse, Net	1[illegible]	0	0	to	130	5	0	
Straits G.M.B., 3 months, Warehouse, Net	1[illegible]	7	[illegible]	to	1[illegible]	10	0	
Australian, Mr Bischoff, Warehouse, Net ...	130	15	0	to	131	0	0	

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B. [illegible] Warehouse, Net ...	69	0	0	to	69	2	6	per ton.
Standard G.M.B. [illegible] months, Warehouse, Net	6[illegible]	7	6	to	6[illegible]	10	0	
English, Tough, Cake & Ingot, Warehouses, Net ...	7[illegible]	0	0	to	71	10	0	
English, Best Select, Warehouse, Net	72	0	0	to	72	10	0	
English, Sheets and Sheathing, f.o.b., Dis 2½	7[illegible]	0	0	to	[illegible]	0	0	
English, Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	
Electro, Warehouse, Net	7[illegible]	0	0	to	70	[illegible]	[illegible]	
Ore [illegible]	0	12	0	to	0	13	0	per unit
Regulus, Matte and Precipitate [illegible]	0	13	[illegible]	to	0	14	0	

YELLOW METAL.

Yellow Metal:	£	s.	d.	£	s.	d.	
[illegible] India f.o.b. Dis. 2½%...				[illegible]	0	[illegible]	per lb
Sheathing				0	0	[illegible]	

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian [illegible] Net ...	[illegible]	[illegible]	[illegible]	to	[illegible]	0	0	per ton
Blende [illegible] Net	[illegible]	[illegible]	[illegible]	to	[illegible]	[illegible]	0	
Calamine Net	[illegible]	[illegible]	[illegible]	to	[illegible]	1[illegible]	6	

LEAD.

	£	s.	d.		£	s.	d.	
English Pig [illegible]	[illegible]	[illegible]	[illegible]	to	[illegible]	[illegible]	[illegible]	per ton
Spanish [illegible]	[illegible]	[illegible]	[illegible]	to	[illegible]	[illegible]	[illegible]	
Lead Ore [illegible] Net	[illegible]	[illegible]	[illegible]	to	[illegible]	[illegible]	[illegible]	

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus [illegible]	[illegible]	[illegible]	[illegible]	to	[illegible]	[illegible]	[illegible]	per ton
Ore [illegible]	[illegible]	[illegible]	[illegible]	to	[illegible]	[illegible]	[illegible]	
Crude [illegible]	[illegible]	[illegible]	[illegible]	to	[illegible]	[illegible]	[illegible]	

QUICKSILVER

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	[illegible]	0	per flask
Italian	[illegible]	15	0	

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Free per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage.

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3¼)	9	6
Small Nuts (¾ to 1½)	6	0
[illegible] Brights	6	0
Peas ([illegible])	5	0
Slack	3	6
[illegible]	2	0

Low Main (or Tupton) Coal:		
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1 to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
[illegible]	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:	s.	d
[illegible]		
Best Hand Picked Hard	9	0
[illegible]	7	9
Hard [illegible]	7	0

Gedling Colliery.		
[illegible]		
London Brights, 4 to 8 in. cube	12	0
Large Nuts [illegible]	9	6
Small Nuts [illegible]	5	6
[illegible]		
Best Hard	9	0
Hard Steam	8	0
[illegible]	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

		£	s.	d.	
Acids:	Oxalic	0	0	2½	per lb.
	Picric, Crystals	0	0	11	,,
	Tartaric ... at Manchester	0	0	10⅞	,,

		£	s.	d.	
Acetate of Lime:	Brown at Manchester net	8	5	0	per ton.
	Grey ,,	11	0	0	,,
Alumina:	Alum, Lump, loose	5	5	0	,,
	,, ,, in casks	5	7	6	,,
	,, Ground, in bags	5	15	0	,,
	Sulphate of Alumina, 14%	4	10	0	,,
Ammonia:	Carbonate	0	0	3⅝	per lb.
	Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
	Sal-ammoniac, Lump, 1sts, del^d U.K.	42	0	0	,,
	,, ,, 2nds, ,,	40	0	0	,,
	Sulphate ... f.o.b. Liverpool	12	15	0	,,
Arsenic:	Best White Powdered ... net	12	0	0	
Bleaching Powder,	35% ... ,,	4	10	0	,,
Borax:	British Refined Crystal ,,	12	0	0	,,

Coal Tar Products:		£	s.	d.	
Benzole, 50/90%	,,	0	0	8	per gal.
,, 90%	,,	0	0	9½	,,
Carbolic Acid Crystals, 34/35° C.	,,	0	0	6⅞	per lb.
,, ,, ,, 39/40° C.	,,	0	0	7⅛	,,
,, ,, Liquid, 97/99%	,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60 F. f.o.b.	,,	0	2	0	,,
Creosote, ordinary good liquid	,,	0	0	1¼	,,
Naphtha, Crude, 20% at 120° C.	,,	0	0	3	,,
,, Solvent, 90% at 160° C. f.o.b.	,,	0	0	8½	,,
,, ,, 95% at 160° C. ,,	,,	0	0	9⅛	,,
,, ,, 90% at 190° C. ,,	,,	0	0	10½	,,
,, Rectified, flash point over 73° F. ... f.o.b.	,,	0	0	11	,,
,, Rectified, flash point over 100° F. ... f.o.b.	,,	0	1	0	,,
Naphthalene, all qualities.					
Pitch ... f.a.s. Manchester.	,,	1	12	6	per ton.

		£	s.	d.	
Copperas:	Green, in bulk ,,	0	12	6	,,
	,, barrels f.o.b. L'pool ,,	1	19	0	,,
	Cake ,,	1	2	6	,,
Copper:	Sulphate	23	0	0	,,
Cyanides:	98% minimum ... f.o.b. net	0	0	8	per lb.
Lead:	Acetate (Sugar) White, English	27	10	0	per ton.
	,, ,, ,, Foreign c.i.f. U.K.	24	5	0	,,
	,, Grey	21	15	0	,,
	,, ,, Brown at Manchester	16	10	0	,,
	Nitrate	24	0	0	,,
	Litharge, Flake	15	10	0	
	,, Powder	16	0	0	
	Red Lead, Genuine, c.i.f. London less 5%	15	10	0	
	White ,, ,, Dry ,,	16	15	0	,,
Naphtha (Wood):	Miscible, 60 o.p.	0	2	10	per gal.
	Solvent ,,	0	2	7	,,
Potash:	Bichromate... delivered England	0	0	3	per lb.
	Carbonate, 90/92% ... c.i.f. Hull	18	0	0	per ton.
	Caustic, 75/80% ,, ,,	20	10	0	,,
	Chlorate ,, net	0	0	3 1/16	per lb.
	Montreal ... in Store, Liverpool	35	0	0	per ton.
	Prussiate, Yellow ... net	0	0	4 15/16	per lb.

		£	s.	d.	
Soda :	[illegible] 48 %, Ordinary ... ,,	5	5	0	per ton.
	Refined	6	5	0	,,
	Carbonated 48 %	5	10	0	,,
	58 % [illegible]				
	[illegible] net	4	10	0	,,
	Electrolytic Refined Caustic				
	50-52 % net	6	10	0	,,
	[illegible] White 77 % ...	10	10	0	,,
	70 %	[illegible]	12	6	,,
	60 %	8	12	6	,,
	Cream 60 %	8	10	0	,,
	C[illegible], [illegible]	3	0	0	,,
	[illegible]	3	7	6	,,
	Acetate .... c.i.f. Hull net	16	10	0	,,
	[illegible]	6	15	0	,,
	Bichromate..... delivered England...	0	0	2¼	per lb.
	Chromate ... net	0	0	3$\frac{1}{16}$	per lb
	Nitrate...ex quay Liverpool, ... ,,	11	0	0	per ton.
	Phosphate ...	9	5	0	
	[illegible] net	0	0	3⅜	per lb.
	[illegible] 140 Tw ...	4	10	0	per ton.
	Sulphate (Glauber Salts) ...	1	12	6	,,
	(Saltcake) 95 %	1	15	0	,,
Sulphur :	[illegible]	4	15	0	,,
	Roll	6	15	0	,,
	Flowers	7	10	0	,,
Zinc :	Sulphate	6	15	0	,,

MINERALS.

		£	s.	d.	
Barytes :	[illegible] Carbonate 90-92 %	3	10	0	per ton.
	Sulphate, No. 1, White	2	15	0	,,
China Clay :	of various qualities for all purposes ; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall : stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore :	Basis 50 %, c.i.f. British Ports	[illegible]	[illegible]	6	
Manganese :	Lump c.i.f. Liverpool 10¼d.	per metallic unit.			
Ochre :	French JC .... f.o.b. Rouen, net	2	5	0	per ton.
	[illegible]	5	10	0	,,
Talc :	(French Chalk) ... c.i.f. Liverpool	3	10	0	,,

OILS, etc.

		£	s.	d.	
Aniline Oil	.... net	0	0	4¾	per lb.
,, Salt		0	0	[illegible]	,,
Castor Oil :	[illegible] 1st pressure [illegible]	[illegible]	[illegible]	0	per ton.
	English, 1st pressure, f.o.r. Hull [illegible]	[illegible]	0	0	,,
Cocoa Nut Oil :	Ceylon, ex store Manchester .... net	30	0	0	
	Cochin, ex store Manchester ... net	[illegible]	0	0	
Cotton Seed Oil :	Refined at Hull, less [illegible]	[illegible]	[illegible]	6	
	Edible at Hull, less [illegible]	[illegible]	7	6	
Glycerine :	Crude, 80 %, ... net	31	0	0	
Linseed Oil :	[illegible] at Hull, less [illegible]	[illegible]	[illegible]	6	
	Refined at Hull less [illegible]	[illegible]	[illegible]	[illegible]	
Starch :	American Pearl, at Manchester, net	9	0	0	
	Dextrine...	18	0	0	
	Farina...............	15	15	0	
Shellac :	Standard TN [illegible]	[illegible]			per cwt.
Turpentine :	American ... at Liverpool	[illegible]	10	0	per ton.
	Russian ...... at Hull.. net	18	10	0	

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote.

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	[illegible]	9	to	0	[illegible]	[illegible]
Quebec [illegible] Pine	,,	[illegible]	[illegible]	8		0	3	[illegible]
St. John Pine, 18 in. average	,,	0	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
Lower Port Pine	,,	[illegible]	1	3		0	1	8
Quebec Red Pine	,,	0	1	[illegible]		0	[illegible]	0
Quebec Oak, 1st quality	,,	0	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
Quebec Oak, 2nd quality ...	,,	0	1	6		0	[illegible]	[illegible]
Ash	,,	0	1	[illegible]		0	[illegible]	[illegible]
Elm	,,	0	3	0		0	3	9
Hickory	,,	0	[illegible]	0		0	[illegible]	[illegible]
Quebec Birch	,,	0	1	[illegible]		0	[illegible]	[illegible]
St. John Birch	,,	0	1	[illegible]		0	2	0
Birch Planks.....................	,,	0	[illegible]	[illegible]		0	0	11
Spruce [illegible]	,,	[illegible]	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	[illegible]	10	0	to	32	10	0
2nd do. do.	,,	[illegible]	0	0		22	0	0
3rd do. do.	,,	[illegible]	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	10	0		6	15	0
Lower Port Spruce	,,	[illegible]	0	0		6	10	0

		£	s.	d.		£	s.	d.
Spruce Boards		5	10	[illegible]		[illegible]	[illegible]	[illegible]

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	[illegible]	[illegible]	to	0	1	[illegible]
Sawn	,,	0	0	10		0	1	[illegible]
Planks, [illegible]	,,	0	0	10		0	1	[illegible]
Boards, [illegible]	per std.	[illegible]	10	0		16	0	[illegible]
Oak Timber	per cub. ft.	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
Oak Planks	,,	0	1	6		0	2	1
East India Teak	per load	[illegible]	0	0		15	0	[illegible]
Greenheart	,,	[illegible]	[illegible]	[illegible]		[illegible]	10	[illegible]

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
[illegible]	per cub. ft.	0	[illegible]	[illegible]	to	0	[illegible]	[illegible]
Dantzic and Memel Fir, [illegible]	,,	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
[illegible] and Memel Fir, Middling	,,	0	[illegible]	[illegible]		0	1	11
[illegible]	,,	[illegible]	1	9		0	1	11
[illegible]	,,	0	1	[illegible]		0	1	[illegible]
Riga Whitewood	,,	0	1	[illegible]		0	1	6
Norway Mining Timber	,,	0	0	[illegible]		0	0	10
Dantzic and Stettin, etc. Oak	,,	0	[illegible]	[illegible]		0	[illegible]	[illegible]
Norway Spars		0	1	[illegible]		0	1	[illegible]

Deals.

		£	s.	d.		£	s.	d.
[illegible] Archangel and Onega 1st quality	per std.	[illegible]	[illegible]	[illegible]	to	[illegible]	[illegible]	[illegible]
[illegible] Archangel and Onega 2nd quality	,,	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
Red Archangel and Onega 3rd quality	,,	12	10	0		15	[illegible]	0
St. Petersburg, 1st quality	,,	16	0	0		17	10	0
Do. 2nd	,,	[illegible]	0	0		15	0	0
Gefle	,,	[illegible]	0	0		17	10	[illegible]
Wyburg	,,	[illegible]	0	0		13	10	[illegible]
[illegible]	,,	[illegible]	0	[illegible]		13	10	[illegible]
Gothenburg	,,	[illegible]	0	0		17	10	[illegible]

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25 Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in italics.

28,773. F. J. Cole and C. J. Mellin, London. Dec. 2[illegible].—Improvements in steam boiler superheaters.

28,799. F. Hodgkinson. London. Dec. 29th.—Improvements [illegible] relating to fluid pressure turbines. (Date applied [illegible].)

28,803. H. Lenz., London. Dec. 29th.—Improvements [illegible] steam or gas turbines. (Date applied [illegible].)

28,807. F. Jottrand, London. Dec. [illegible] method of [illegible] for [illegible] pipes, plates [illegible].

28,810. E. Langheinrich, London. Dec. 30th.—Improvements [illegible] pumps.

28,893. D. R. Todd, Glasgow. Dec. 30th.—Improvements [illegible] tube boilers.

28,894. S. Couper and J. S. Millar, Glasgow. Dec. 30th.—An improved superheater for steam.

28,907. C. G. Day, Manchester. Dec. 30th.—Improvements [illegible] steam traps.

28,921. C. Wamser, Germany. Dec. 30th.—Improved apparatus for automatically closing the smoke side on opening the [illegible] doors of steam boiler furnaces.

28,924. A. Brake, London. Dec. 30th.—Improvements in [illegible] heating [illegible]. (*Mann Bros. and Thomson, Nova Scotia* [illegible].)

28,941. A. Clark, Glasgow. Dec. 30th.—Rotary engine [illegible].

28,957. N. Vicente, London. Dec. 30th.—Improvements [illegible] connected with the regulating valves of steam engines.

28,972. Sir. J. I. Thorneycroft, London. Dec. 30th.—Improvements [illegible] boilers.

29,978, J. E. Evans-Jackson, London. Dec. 30th.—Im[illegible] pumps. (*[illegible] Pump Company, U.S.A.*)

29,031. E. Edwards, London. Dec. 30th.—Improvements [illegible].

29,032. G. Harris, London. Dec. 30th.—Improvements [illegible].

29,060. L. Renault, London. Dec. 30th.—Improvements in [illegible]. (Date applied [illegible].)

29,090. J. Fleischmann, London. Dec. 30th.—Improvements [illegible].

29,102. A. A. W. van Reede, London. Dec. 30th.—Im[illegible].

29,105. R. H. Davis and Siebe, Gorman and Co., Ltd., London. [illegible]

29,134. C. F. de Kierzkowski-Steuart, London. [illegible]

29,171. W. J. Greaves, London. [illegible]

29,173. P. Kestner, London. [illegible] Improvements in [illegible].

29,230. E. W. Robey, and A. Rink, London. Dec. 31st.—Improvements in automatic draught regulating apparatus for steam boilers and other furnaces.

29,232. J. C. Merryweather and C. J. W. Jakeman. London. Dec. 31st.—Improvements in steam engines.

29,280. J. W. Cloud, London. Dec. 31st.—Improvements relating to marine propulsion.

29,318. F. L. Croft, T. A. Perkins and F. Croft, Bradford. Dec. 31st.—Improvements in or relating to the bearings of shafting and the supports therefor.

29,391. P. Mickelheit, London. Dec. 31st.—Improvements relating to separators for removing oil from steam.

29,399. A. Bagshawe, London. Dec. 31st.—Improvements in or connected with [illegible] excavators.

29,426. D. B. Morison, London. Dec. 31st.—Improvements in apparatus for cleansing steam and heating water.

29,451. W. E. Evans, London. Dec. 31st.—Improvements relating to steam heating apparatus. (*C. H. [illegible], Germany.*)

29,536 J. W. C. Prochnow, Kingston-on-Thames. Dec. 31st.—Improved gauge cock for steam boilers.

29,548. N. Foley, London. Dec. 31st.—Improvements in and relating to steam traps.

29,559. T. Downie, Liverpool. Dec. 31st.—Improvements in or connected with steam generators and [illegible].

29,560. T. Reading and A. J. Houghton, Liverpool. Dec. 31st.—Improvements in pistons and piston valves and their packings.

29,563. J. Butterworth and Lancaster and Tonge, Ltd., Manchester. Dec. 31st.—Improvements in piston and [illegible] rings.

29,574. P. Dawson, Glasgow. Dec. 31st.—A combined balanced draught and smoke annihilating apparatus for ships.

29,596. E. Bennis, Manchester. Dec. 31st.—Improvements in furnaces for steam generators and other purposes.

29,597. E. Bennis, Manchester. Dec. 31st.—Improvements in furnaces for steam generators and other purposes.

29,629. H. Scharbau, Manchester. Dec. 31st.—Improvements in [illegible] steam or gas turbines.

29,651. H. Cruse, Manchester. Dec. 31st.—Improvements in water tube boilers.

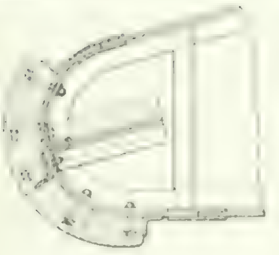
29,654. G. Johnston, Glasgow. Dec. 31st.—Improvements in connecting rods.

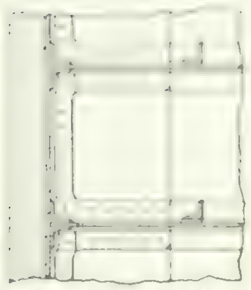
RECENT SPECIFICATIONS.

DOCK GATES.

Sir W. G. Armstrong, Whitworth and Co., Ltd., and Roger Wright, of Newcastle-on-Tyne. Feb. 12, 1904.—Dock gates as at present constructed are provided with a heel post, consisting of an approximately semi-circular baulk of timber constituting the pivot about which the gate turns and forming a water-tight joint between the edge of the gate and the [illegible]. To obviate the [illegible] of the [illegible] gate, especially in the larger sized gates, [illegible] gate in which the heel post is entirely dispensed with, the edge of the gate itself being formed [illegible] approximately semi-circular [illegible] being faced with timber. The construction is [illegible]. The gate is as usual a hollow structure built up of plates stiffened with horizontal ribs. At the side of the gate near the [illegible] these plates are, according to this invention, bent into the arc of a circle of such a radius as to give ample bearing surface.

[illegible]

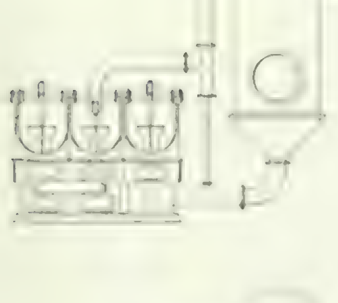


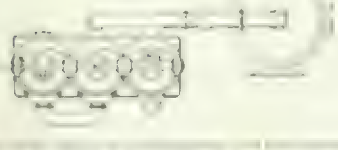


[illegible]

STEAM CONDENSERS.

C. Day and W. A. Dexter of The Mirrlees Watson Company Ltd., of Glasgow. [illegible]

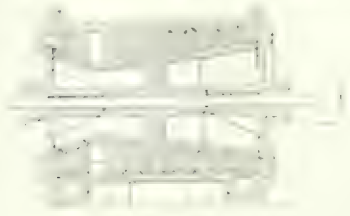




[illegible]

TURBINES.

E. T. Pollard, London. [illegible]



[illegible]

CALENDARS AND DIARIES.

[illegible]

[illegible] castings, etc.

[illegible] reproduction of the Yost machine.

[illegible] the Leadenhall Press. This is executed on parchment [illegible]

NEW PUBLICATIONS.

"THE FAN:"

Including the Theory and Practice of Centrifugal and Axial Fans. By Charles H. Innes, M.A. Technical Publishing Company, Ltd., Manchester. 4s. net.

Those responsible for the efficient working and the designing of fans would do well to make themselves acquainted with Mr. Innes profusely illustrated volume. The work differs considerably from any other book on this subject. The writer adopts the theory of the centrifugal pump and applies it to the fan, and in the chapters devoted to a comparison between theory and experiment, he gives some interesting data to show that his theory agrees with the results of experiments. Specially interesting are the descriptions which are given of the centrifugal fan, the Rateau high-pressure fan, and the Screw fan.

"ELECTRIC FURNACES AND THEIR INDUSTRIAL APPLICATIONS."

By J. Wright. Archibald Constable and Co., Ltd. 8s. 6d.

The metallurgist will welcome the appearance of this singularly complete treatise, which is calculated to make an admirable companion to Professor Moissan's "Le Four Electrique," to which we recently called attention. The volume now before us is probably less exclusive in its scope than the former; the writer has embodied in his work a deal of information quoted from sources not easily accessible to the average student. Mr. Wright's volume presents, in a concrete form, a complete record of the many applications of the electric furnace in modern industry. After a concise account of its evolution, the writer discusses the arc furnace, pointing out the advantages of three-phase currents for electric furnaces of this type; attention is paid next to resistance furnaces, typical processes, and calcium carbide manufacture. An important section of the work deals with iron and steel production in the electric furnace, details of the various processes are given, and a number of authoritative statements from metallurgists of recognised standing are included. Other chapters are devoted to the manufacture of phosphorus and glass by means of this furnace; electrolytic furnaces and processes; miscellaneous electric furnace processes; laboratory furnaces and experimental research; tube furnaces; terminal connections and electrodes; efficiency and theoretical considerations, and the measurement of furnace temperatures. The illustrations are all that can be desired from a technical standpoint, representing constructional details rather than actual views of the objects.

"YEAR BOOK OF THE SCIENTIFIC AND LEARNED SOCIETIES OF GREAT BRITAIN AND IRELAND."

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This indispensable annual has now reached its twenty-first year of publication, and its pages bear ample evidence of full maturity. The brief, but accurate, chronicle of the transactions of the various societies during the above year should prove of incalculable value to anyone engaged upon scientific research.

NEW CATALOGUES.

From Mr. John Thom, of [illegible] Works, Patricroft, we have received a catalogue of Boring Plants which are described and illustrated: Percussion and Hand Boring Plants, Smiths' Tools, Steel Boring Tubes for Borehole [illegible] Pumps, Diamond Boring Plants, etc. Profusely illustrated catalogues of Steam Valves and Fittings, Water Raising Appliances, and Waterworks Appliances are also to hand from this firm.

The Horsfall Destructor Company, Ltd., of Leeds and London, have issued a booklet neatly and strongly bound in green [illegible] Destructors. The first few pages of this publication are devoted to a list of "Horsfall" Patent Destructors at work or under construction; after which the system is briefly described. The bulk of the book however consists of full-page illustrations of Destructors erected in various districts, with suitable descriptions on the opposite pages.

Pamphlet No. 177 issued by the British Thomson-Houston Company, Ltd., is devoted to Rheostatic Controllers and Resistances and supersedes Pamphlet No. [illegible]. It includes several half-tone illustrations.

The Lahmeyer Electrical Company, Ltd., of [illegible] New Oxford Street, W.C., have issued a four-page circular (Description No. [illegible]) dealing with their [illegible] motors type D and Ds. We learn that these new motors are fitted with improved patent ball bearings, as recently illustrated and described in PAGE'S WEEKLY, manufactured by the Deutsche Waffen- und Munitionsfabriken, Berlin, by means of which it is claimed that the oil consumption and frictional losses are greatly reduced.

Messrs. J. Hopkinson and Co., Ltd., Huddersfield. List No 240 describes the firm's Patent "Centre Pressure" Valve, a new form of stop valve for turbines, engines, boilers and pipes. This pamphlet, which is well printed and arranged, contains several diagrams and [illegible].

Messrs. W. F. Dixon and Co., of 63, Percival Street, Manchester, forward circulars calling attention to their Improved Metal Bushed Raw Hide Gear Wheels for silent driving.

A pictorial publication illustrating Shop Divisions as constructed by The New Expanded Metal Company, Ltd., of Stranton Works, West Hartlepool, has been received by us. It includes some excellent half-tone blocks printed in sepia toned ink, showing interior views of different works in which divisions manufactured from this expanded metal have been erected. Amongst others we notice views of the machine shop and ground floor at the works of the British Westinghouse Electric and Manufacturing Company, Ltd., and interior views of the works of the Lancashire Dynamo and Motor Company, Ltd. We have also received illustrated leaflets dealing with other uses for the metal, such as letter sorting racks, gates, etc.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, JAN. 20th.—Institution of Mechanical Engineers: Storey's Gate, S.W., 8 p.m. Paper: "Some Impressions of American Waterworks [illegible]," by Mr. A. J. [illegible]. [illegible] Mr. John Barr. [illegible] 6.30 p.m.—Electric Harmonic Smoker: Holborn Restaurant, [illegible] p.m.

SATURDAY, JAN. 21st.—[illegible] 7.30 [illegible] "The Stirling Boiler," by Mr. C. E. Parbolton. Royal Institution, [illegible].

MONDAY, JAN. 23rd.—Institution of Marine Engineers: Stratford, 8 p.m. [illegible] 8 p.m. Cantor Lecture: "[illegible] Stylographic and Fountain Pens," Mr. James P. Maginnis.

TUESDAY, JAN. 24th.—[illegible] Mr. [illegible] Brenan.

WEDNESDAY, JAN. 25th.—[illegible] "Design and Work of Pressing, Stamping, Forging and Similar Machines," Mr. [illegible] "London Electric Railways," Hon. Robert P. Porter.

FRIDAY, JAN. 27th.—Engineering Society: University College, London, [illegible] p.m. Paper: "The [illegible] of the [illegible]," by Mr. [illegible].

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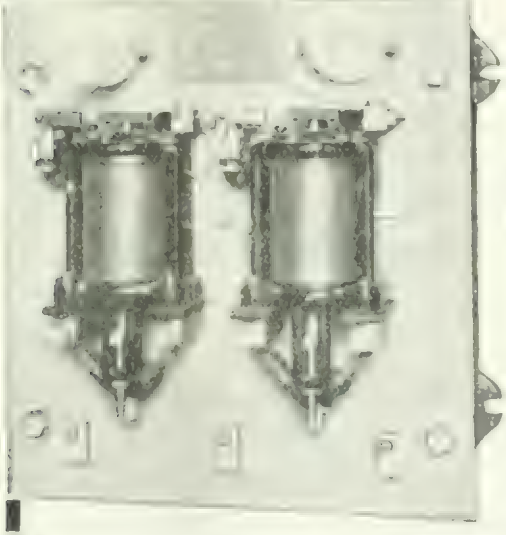
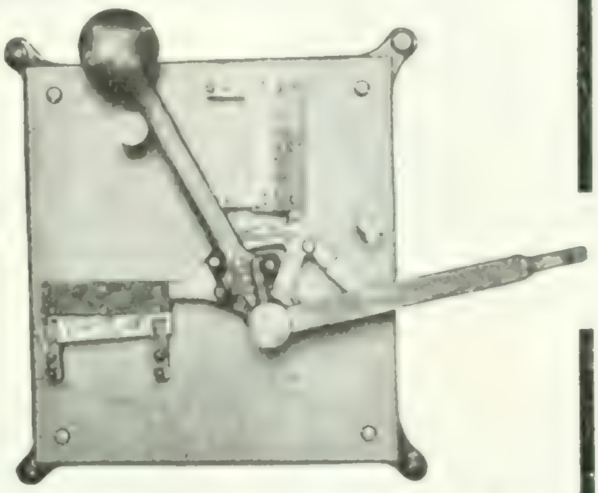
RHEOSTATS.



LEAFLET

P.M. 73.



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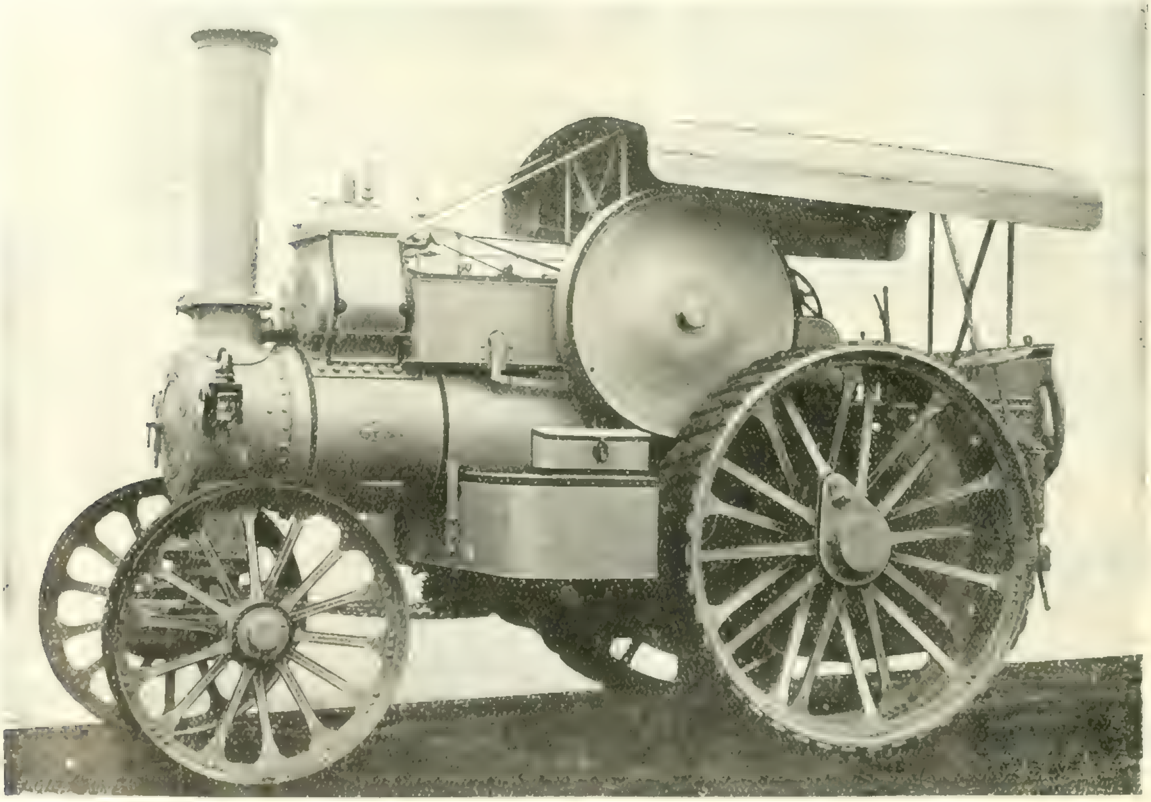

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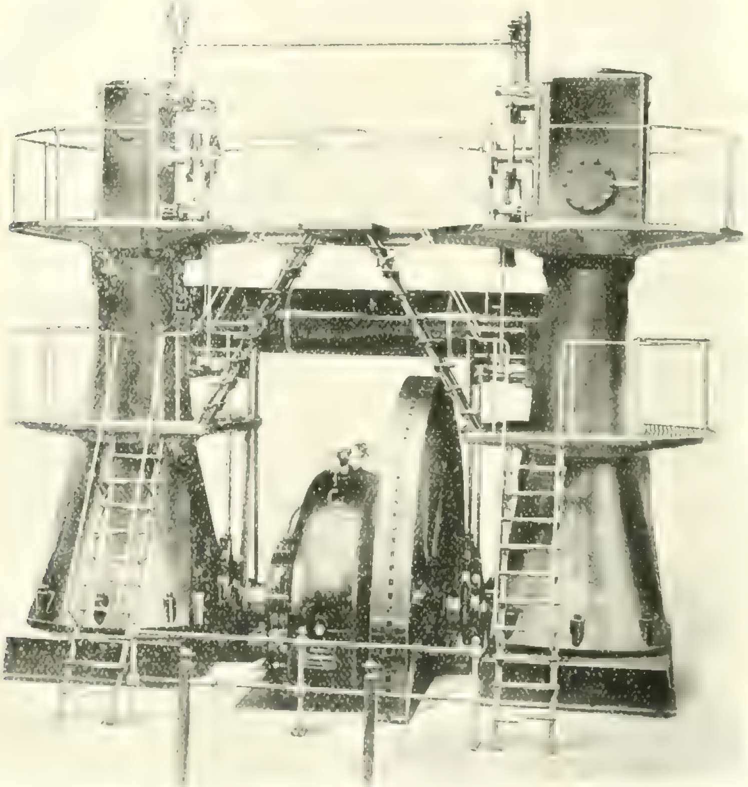

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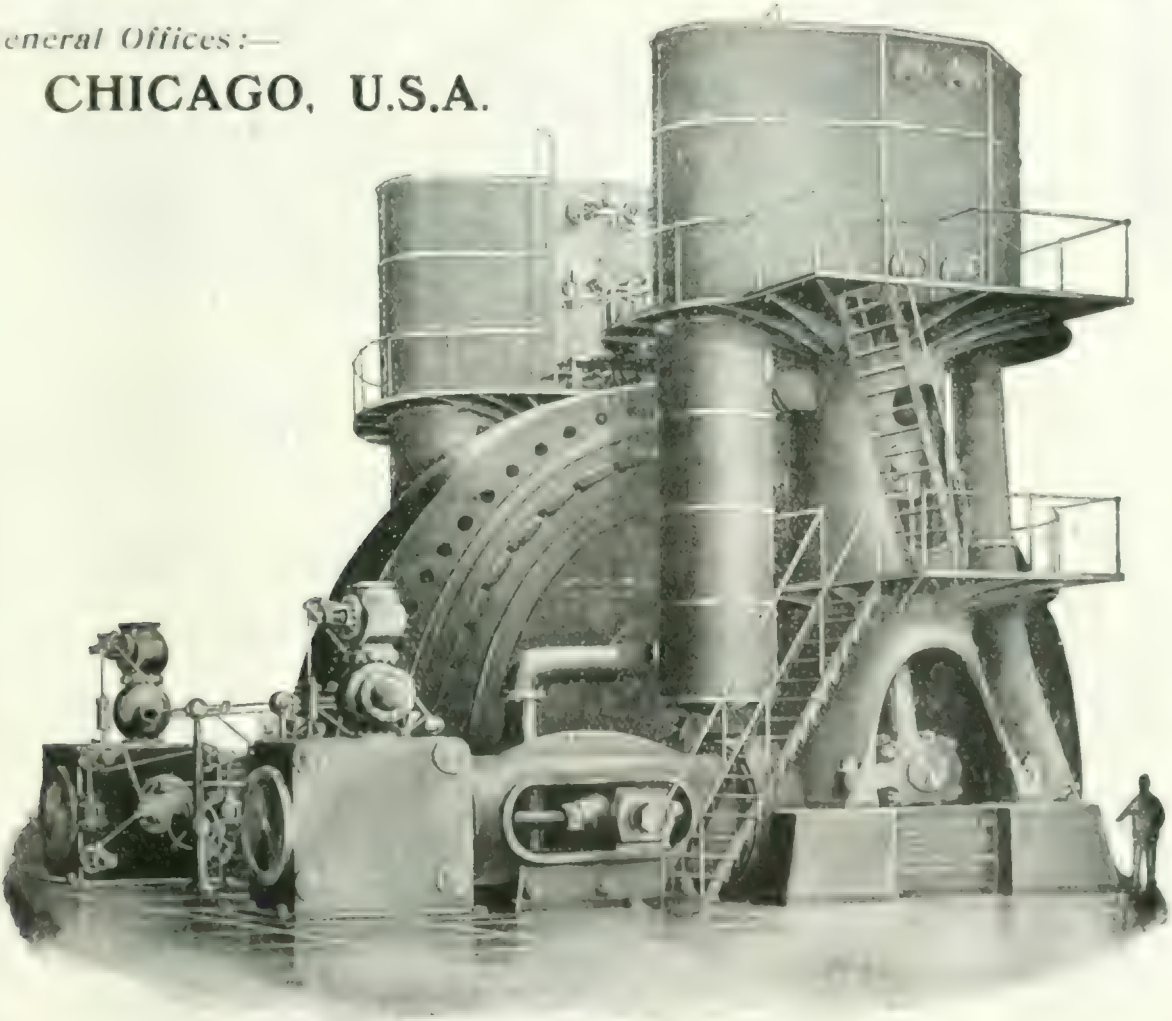

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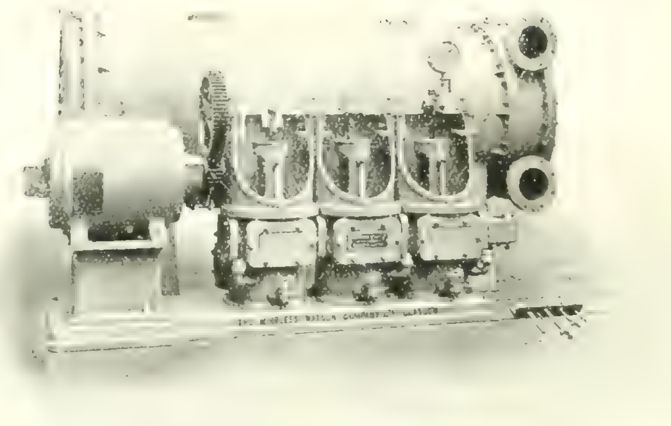

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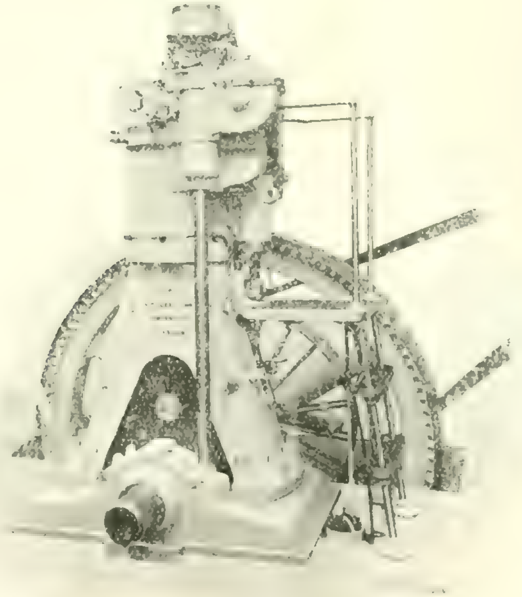

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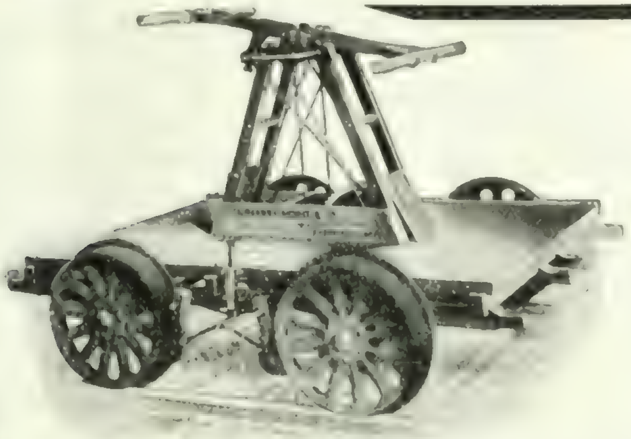

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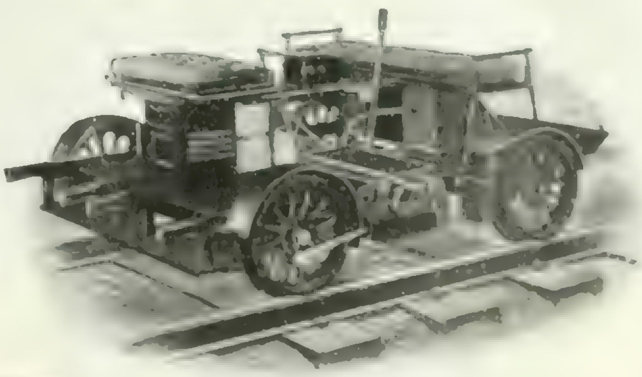

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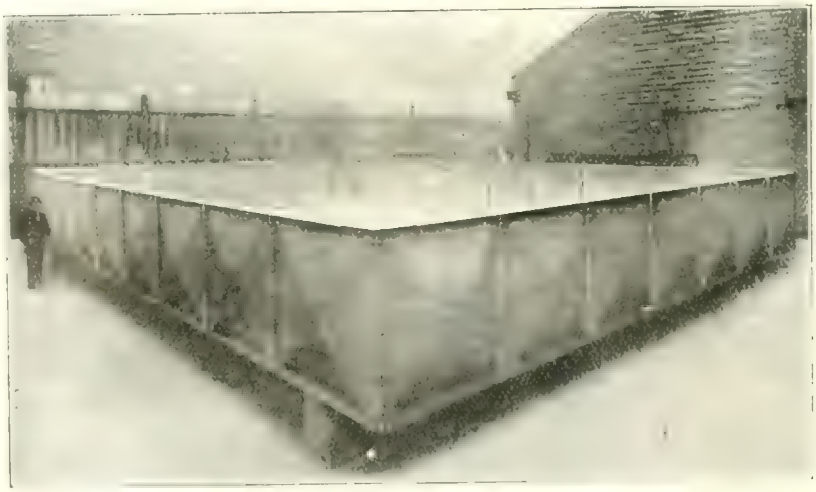

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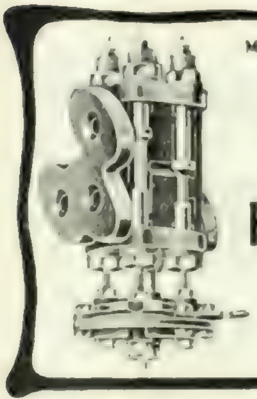

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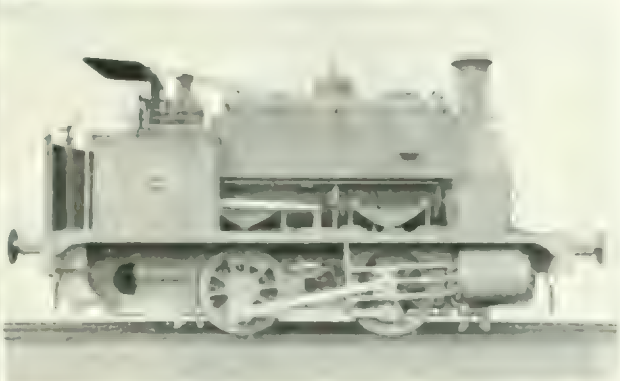

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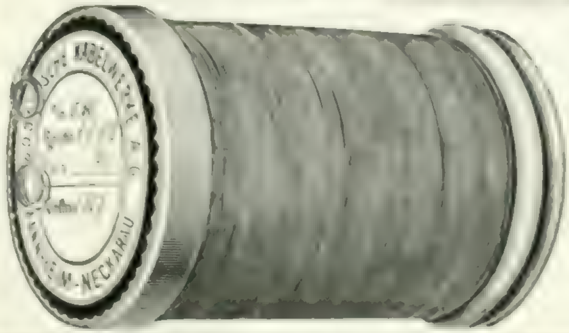

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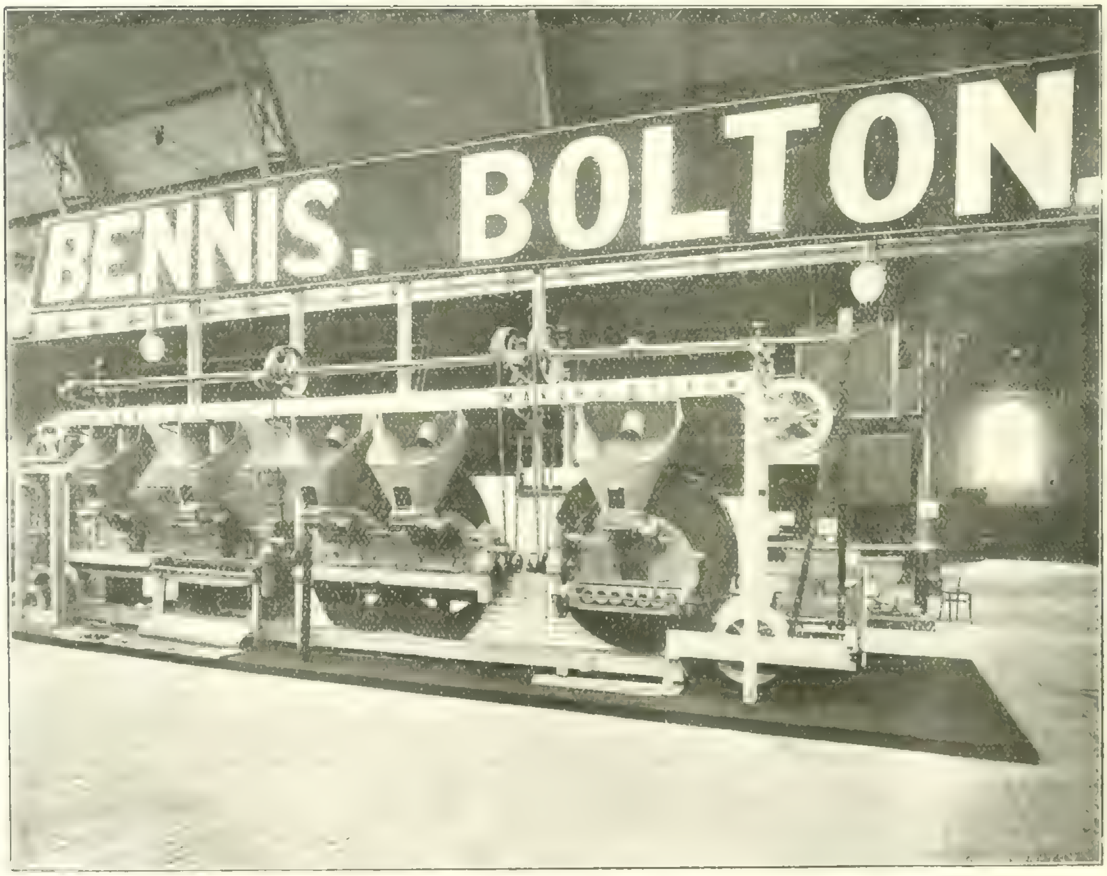

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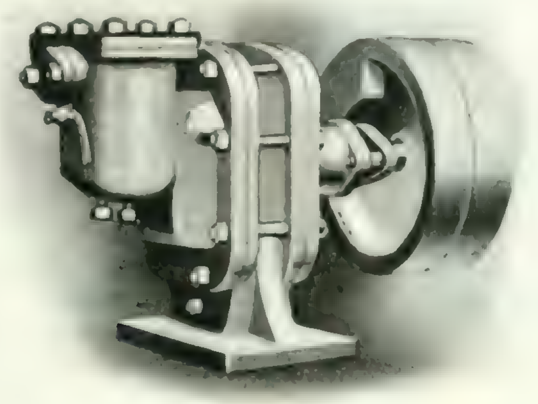

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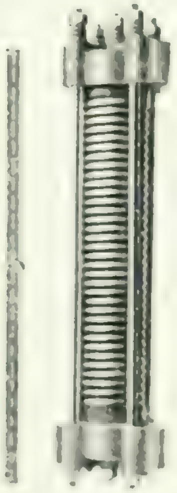

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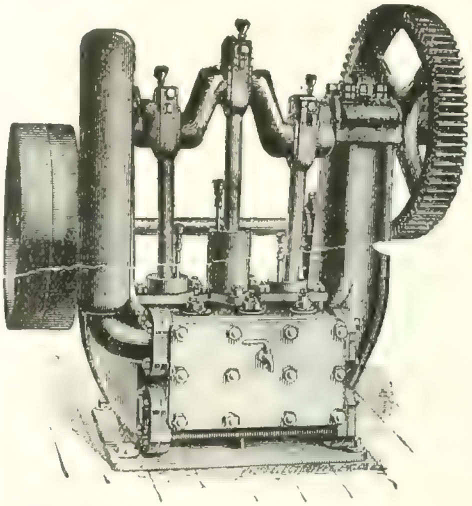

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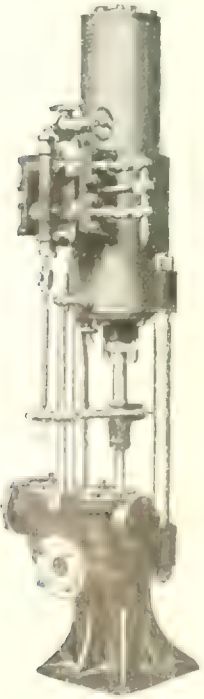

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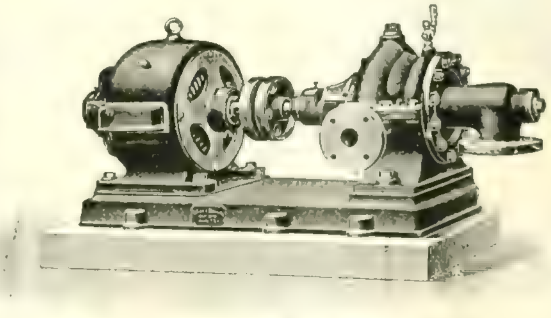

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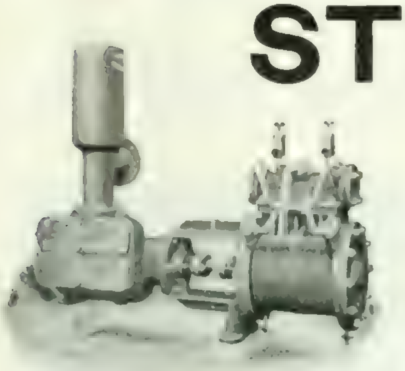

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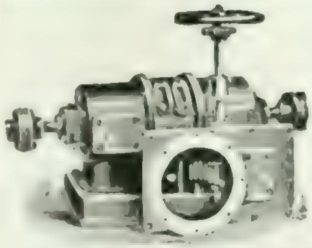

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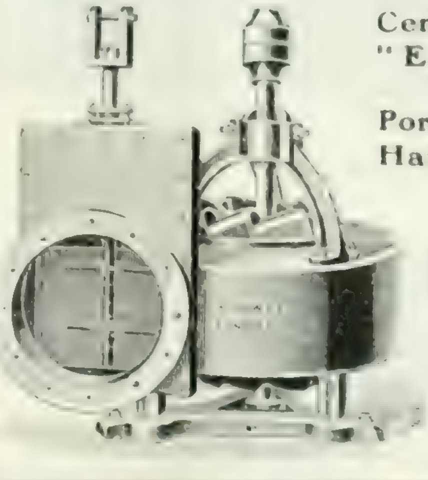

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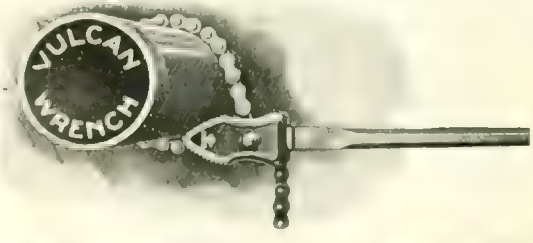

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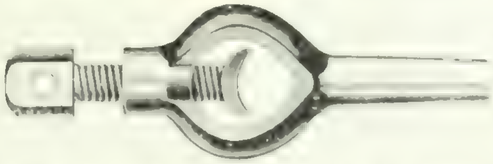

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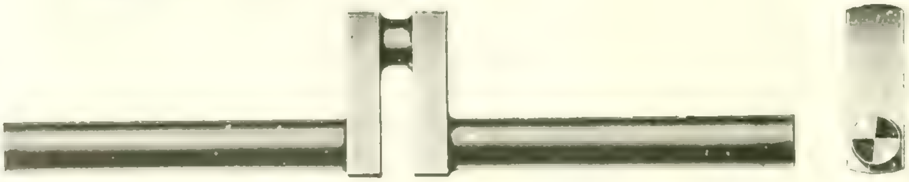

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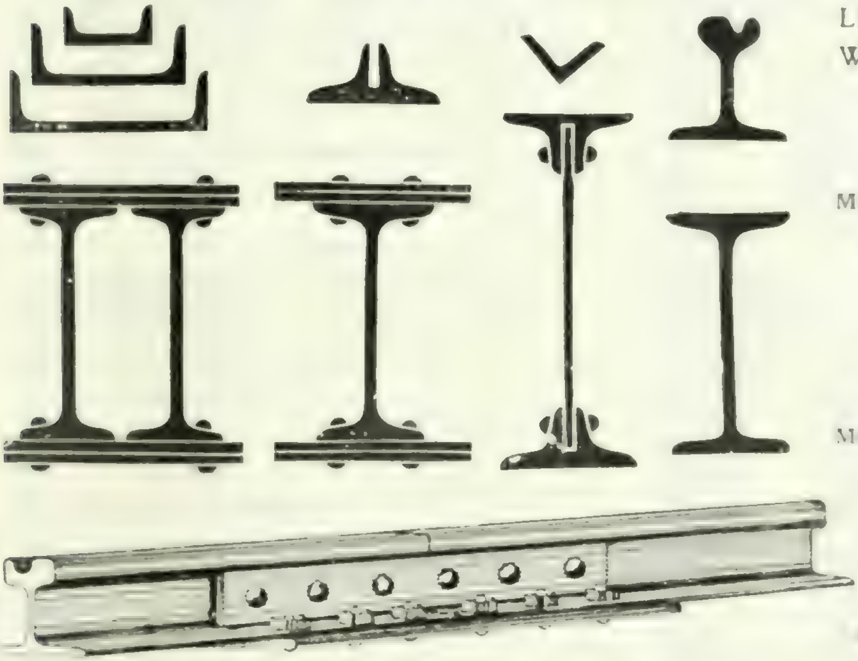

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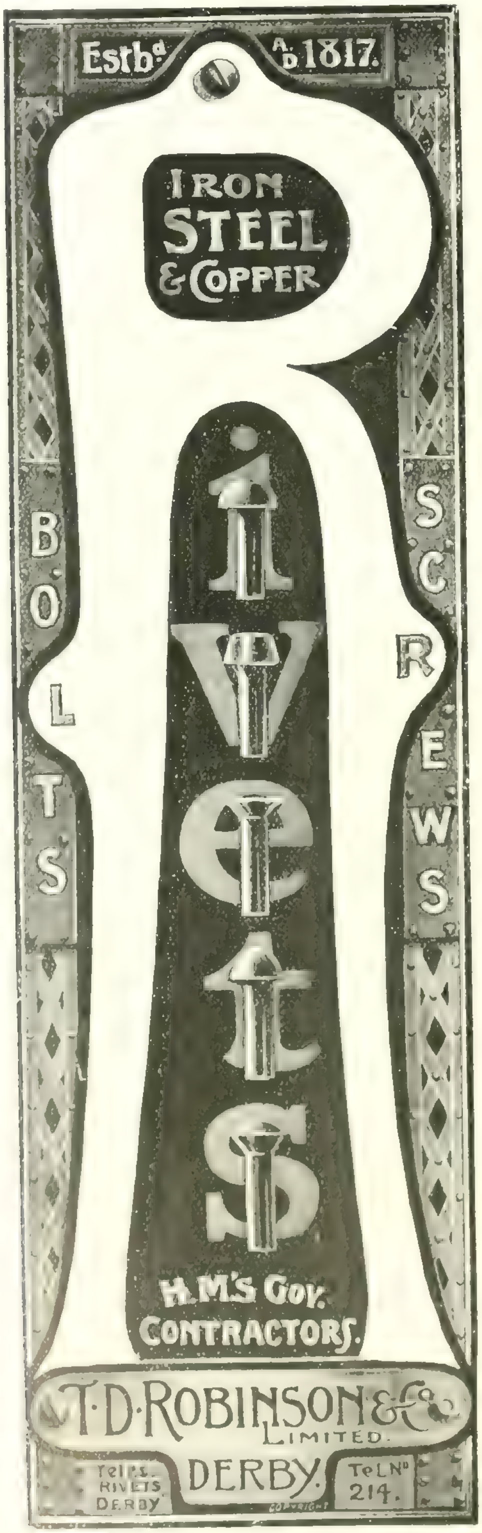

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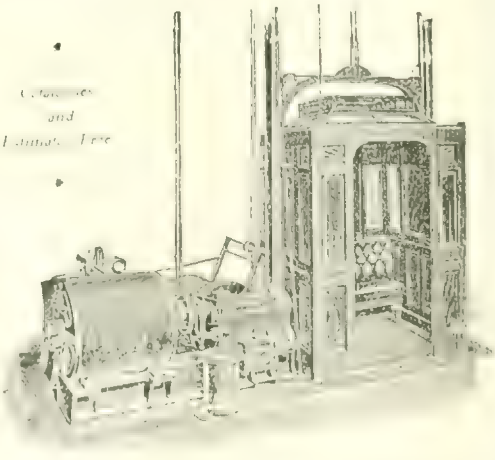

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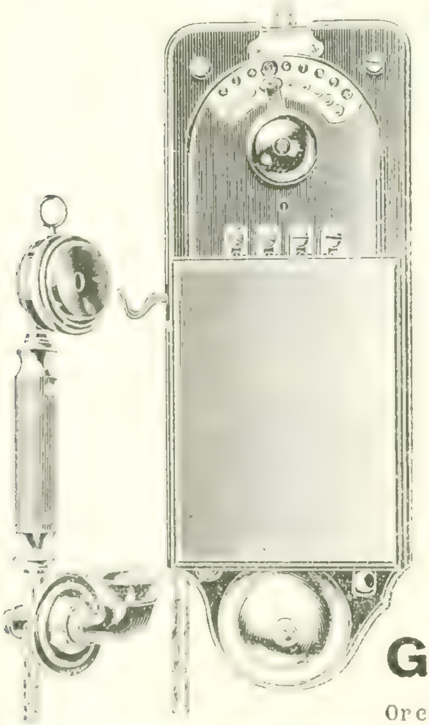

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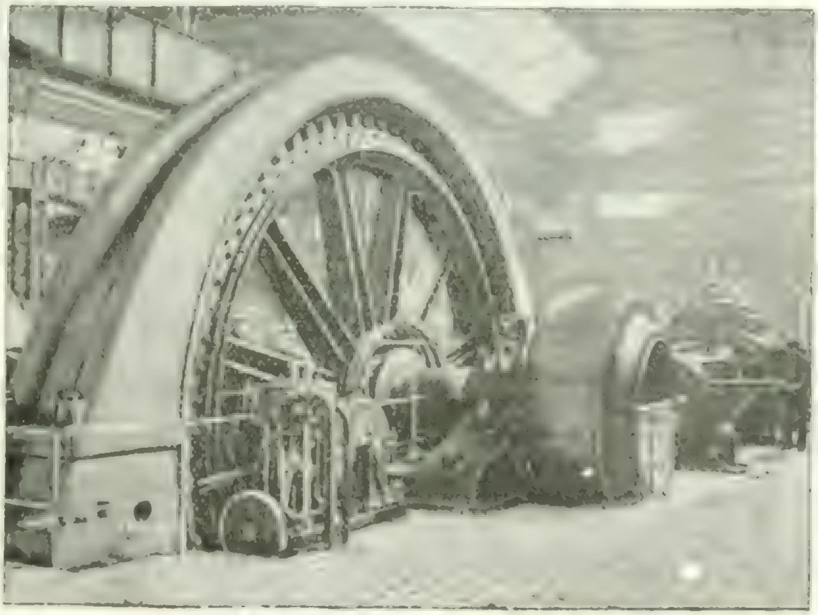

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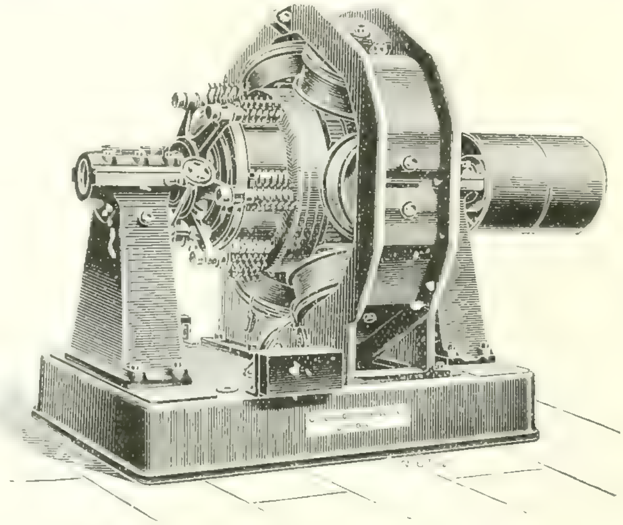

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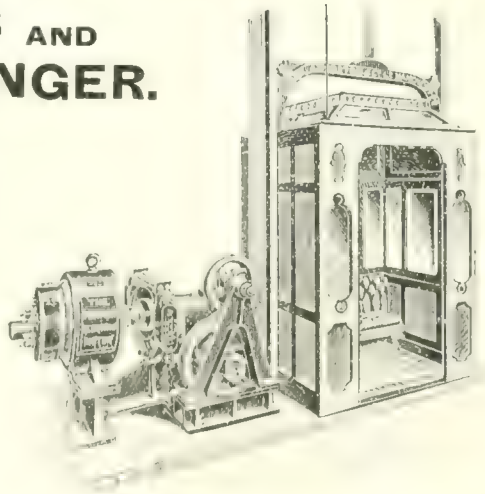

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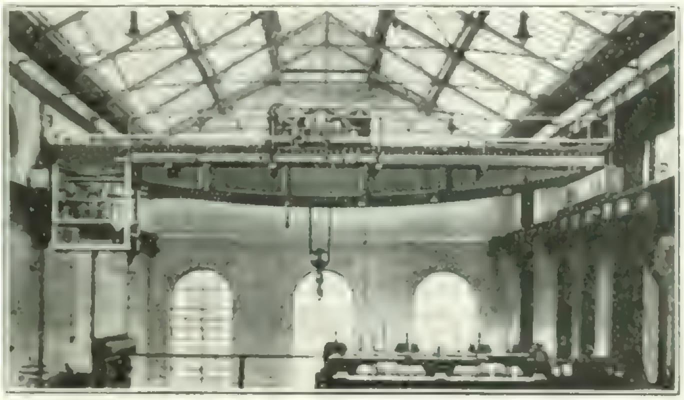

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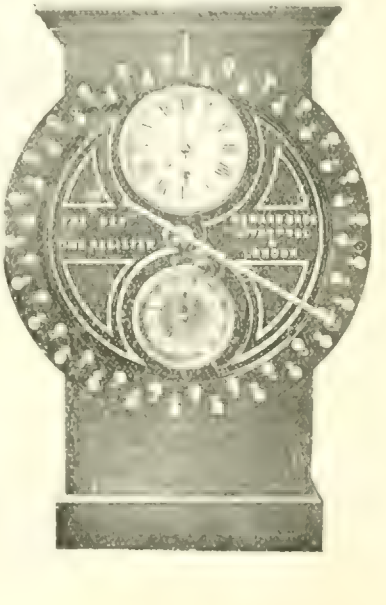

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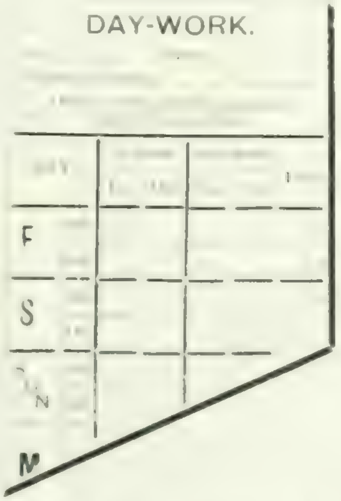

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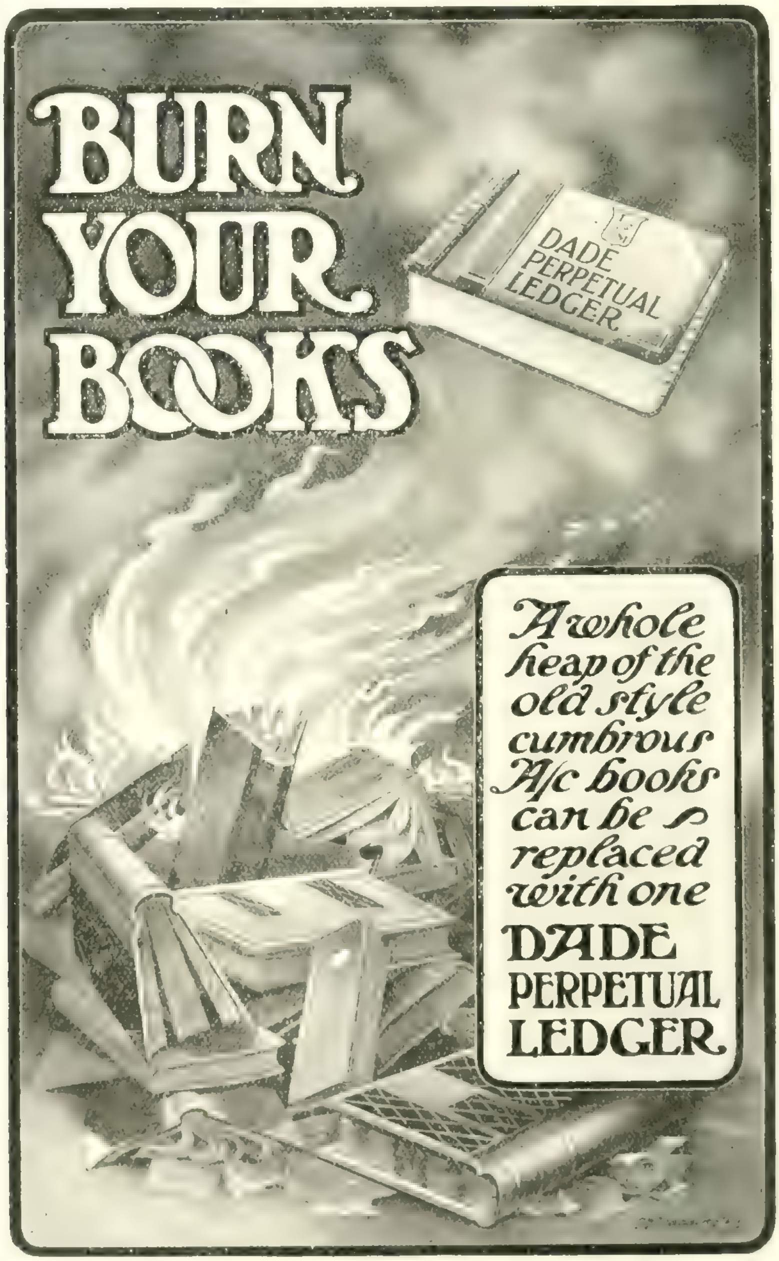

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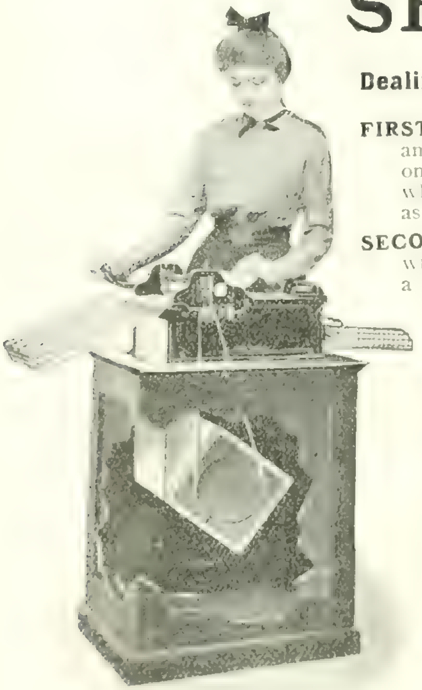

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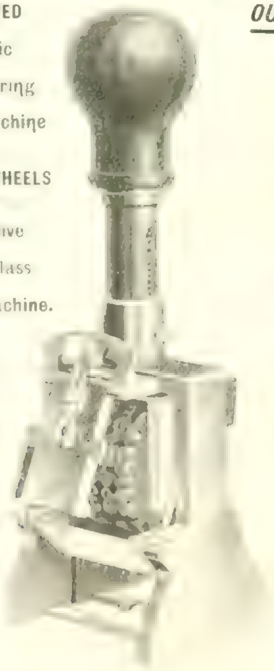

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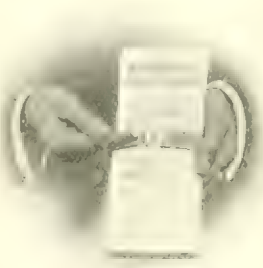

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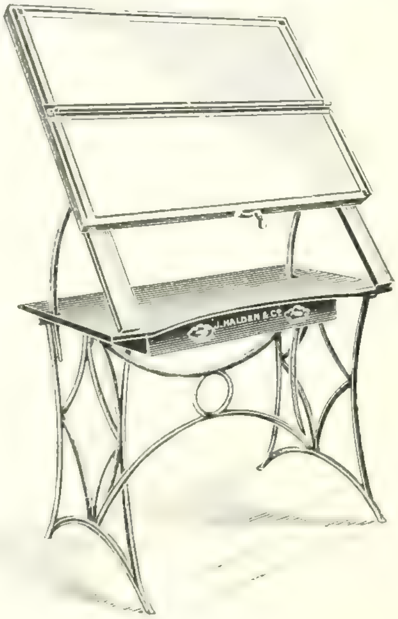

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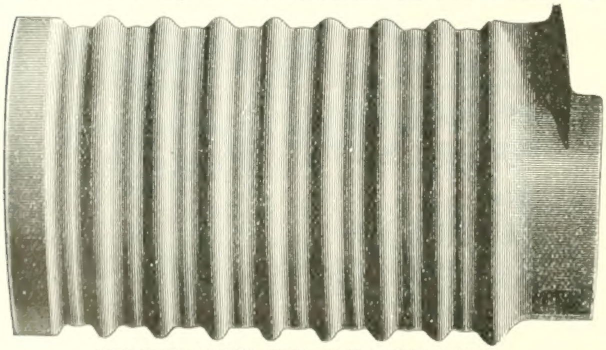

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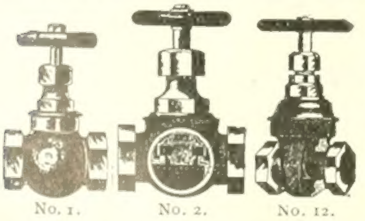
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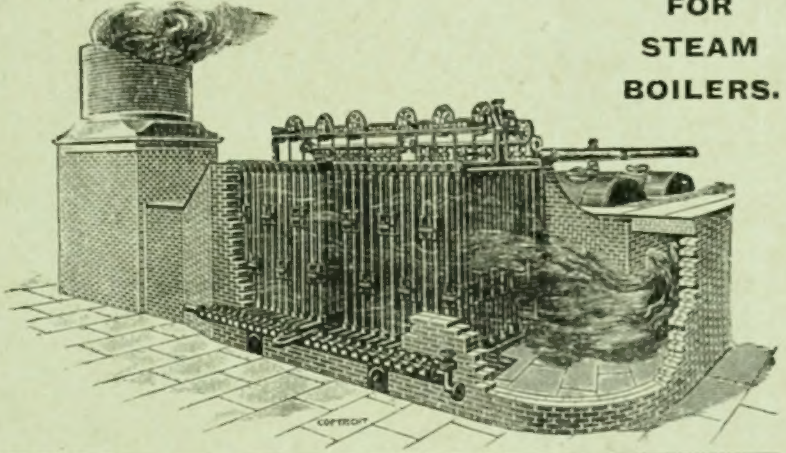

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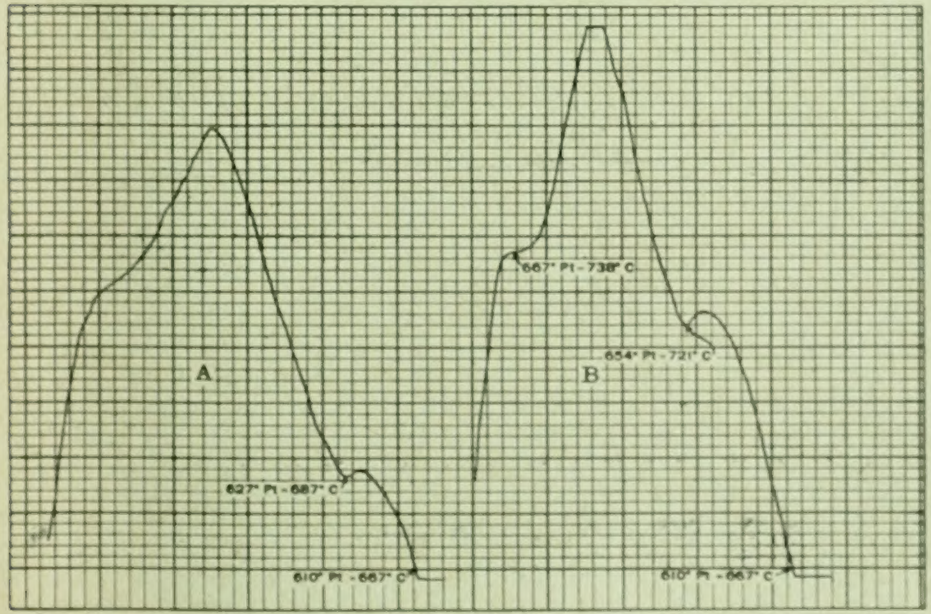

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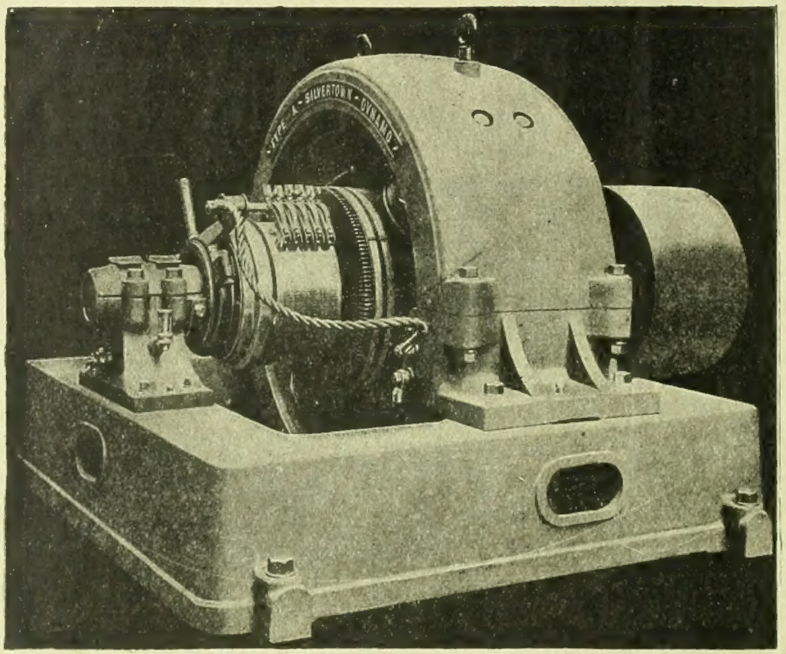

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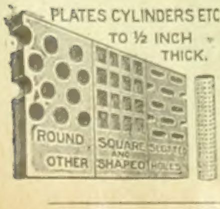

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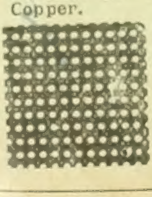

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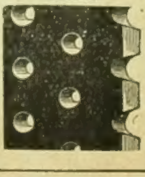

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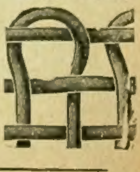

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